SYLLABUS OF MEDICAL HISTORY

Historia Medicinae

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For Students and Teachers

I M H O T E P

SYLLABUS OF MEDICAL HISTORY

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An acquaintance with the history of his science, is, however, especially indispensable to the practical physician, if he would thoroughly comprehend and penetrate the secrets of his profession. To him, indeed, it is the bright and polar star, since undoubtedly it alone can teach him the principles of a medical practice independent of the currents, the faith and the superstition of the present. Moreover, it offers him a scientific gain, through the knowledge of the past, the measure for a just and well-founded criticism of the doings of his own time, places in his hand the thread by which he unites past conditions and efforts with those of the present, and sets before him the mirror in which he may observe and compare the past and present, in order to draw therefrom well-grounded conclusions for the future.

—JOHANN HERMANN BAAS.

I repeat that contemporary investigation has not, as yet, got far enough in any field of medical history to attempt anything of lasting value: that is the conclusion drawn from my renewed exegesis of the history of medicine during recent years. Acting upon this clear perception, I beg leave to sound the call: To work! To the unceasing work of many years; yes even to those who, like myself, would like to create artistic shapes in the round, I say: To work, with spade, pick-axe and hammer in hand!

—KARL SUDHOFF.

Dr. Oliver Wendell Holmes, in one of his addresses, urges his hearers not to look with contempt on their old medical books: "The debris of broken systems and exploded dogmas," he continues, "form a great mound, a Monte Testaccio of the shards and remnants of old vessels which once held human beliefs. If you take the trouble to climb to the top of it, you will widen your horizon, and in these days of specialized knowledge your horizon is not likely to be any too wide." Now that the period of purely professional education has been prolonged, the tendency to this narrowness of view is likely to increase, and no better antidote could possibly be found than the study of medical history, a subject which makes us acquainted with the most diverse forms of thought, and brings before us every phase of civilization.

—EDWARD THEODORE WITHINGTON.

A central institute and library, devoted to the promotion of systematic investigation into the historical documents of science, is greatly needed in this country. Such a foundation would do much to place the subject on its proper academic basis and would rapidly react on the whole system of scientific education. It would help the teacher to present the sciences in their evolutionary relation to each other and to the course of history as a whole. It would especially help the teacher of science to develop his subject as the product of a progressive revelation of the human spirit rather than as a mere description and attempted explanation of the phenomena. We may well look to this new orientation of scientific teaching to counteract the effects of the regrettable but real decline in the study of the older "humanities."

—CHARLES SINGER.

We insist above all upon austerity. The bane of our studies is that too many men of science approach them in a spirit of dilettantism. They may be extremely careful and austere with regard to their own work, but as soon as they touch history they expect to be entertained. Now this is preposterous. The history of science is like any other subject; it has its high spots, its dramatic moments, its romantic interludes, but these cannot be separated from the duller background without loss or danger. Men of science must learn that here as elsewhere it is best to leave things in their original setting. Those who want only the cream of history will never benefit by it, nay, they will hardly appreciate it when they get it; like people trying to feed on dainties alone, they will be surfeited before being nourished.

—George Sarton.

Am I wrong then in assigning to medical history and biography an important place in the medical curriculum of today? I would have it systematically taught in every medical school. Even in the courses preparatory to medicine I would have it introduced. From how many medical disappointments, woes and scandals would we be saved if every pupil who seeks matriculation in a medical school should first have read such a work as Fielding Garrison's History of Medicine!

—Lewis Stephen Pilcher.

Less than one hundred years ago, medical history was an iron-bound part of medical education. Not only was it taught in the majority of the universities, but it was required that every anatomist, and every teacher of medicine be familiar with the history of medicine of his particular branch, and that he possess a knowledge of the literature not only limited to the last few decades. The fact that the history of medicine is now obliged, slowly and humbly, to fight for a place for itself, is due not merely to the gradually diminishing humanitarian spirit of the physicians, but lies deep in the development of modern medicine.

—Henry E. Sigerist.

Foreword

In unravelling the development of any science, we unwind the first uncertain strands in Egypt and Babylon, proceed properly in Greece, slacken our pace among the Byzantines, lose the thread in the twilight of medievalism, then pick up the long-broken skein in the Renaissance and carry it forward to the present day. The author's course in the History of Medicine is a pictorial one, being illustrated with several hundred slides. This graphic presentation enables the student to see the history of his profession as a developing panorama throughout the ages. The following subjects are emphasized and illustrated:

I. Primitive Medicine—Origin of Trephination, Venesection and Therapeutics.

II. Egyptian and other ancient forms of medicine.

III. Origin of Sacred Medicine in Greece.

IV. Development of Secular Medicine in Greece.

V. Greek Medicine in Alexandria.

VI. Greek Medicine in Rome.

VII. Arabian Medicine in the Middle Ages.

VIII. Medieval Medicine—Latency of the Experimental Method.

IX. Medicine in the Renaissance—Reawakening of the Experimental Method.

X. The Quest for Human Anatomical Material for Dissection.

XI. Anatomy and Physiology in the Seventeenth Century.

XII. Medical Leaders and Chemists of the Eighteenth Century.

XIII. Pathfinders in Medicine in the Nineteenth Century.

XIV. Art, Satire and Caricature in Medicine.

XV. Landmarks in American Medicine.

This Syllabus consists of specimen questions and answers from the author's course; a specimen essay from his "Pathfinders in Medicine"; and a specimen chronology which he has brought down to 1925. As an exercise, pupils may readily complete the

subsequent years by consulting the items in the Index-Catalogue of the Library of the Surgeon-General's Office (third series) and the recent volumes of the Quarterly Cumulative Index Medicus (American Medical Association). Numerous preposterous errors would be avoided if checked up with chronology. For example, on page 116 of a very popular medico-historical work, published by the House of Harper (1929), the following story occurs:

> Within two years after his paper describing his first use of chloroform at childbirth, Simpson was able to report that it has been administered to from 40,000 to 50,000 persons in Edinburgh both for childbirth and for surgical operation. Simpson established this advance toward the conquest of death and suffering at birth, and, unlike the unfortunate Semmelweis, lived to see the success of his efforts. He was honored locally, he was knighted, and at his death in 1870 the shops of the city closed while the people went to view the enormous procession of those who attended his funeral. In connection with his title of knighthood it is said that Sir Walter Scott wrote to Simpson and suggested as a coat of arms suited to his work on anesthesia at childbirth, "a wee naked bairn" with underneath the motto, "Does your mother know you're out?"

This story, which has amused (and misled) many readers, is destroyed by chronology. Sir Walter Scott, like Goethe, died in 1832. In that year, Simpson received his medical degree; he did not discover the anesthetic properties of chloroform until 1847, and did not receive the baronetcy until 1866: by this time Scott had been dead for over a generation, and hence could not have suggested a motto for Simpson's coat of arms. The book from which we have quoted is a mass of mistakes, but even scholarly volumes frequently require chronologic control.

The Photostat is so useful a tool for medico-historical students that we conclude the Syllabus with an article on this subject by Mr. Charles Perry Fisher, Librarian of the College of Physicians of Philadelphia (Medical Life, July 1922; revised by Mr. Fisher for the Syllabus). The photostatic reproductions are from Dr. Morris Hirsch Kahn's "Historical Survey of our Knowledge of Bronchial Asthma" (Bronchial Asthma Number of Medical Life, March 1928).

For several of the specimens of Early Medical Illustrations we are indebted to Professor Karl Sudhoff of Leipzig.

V. R.

EDITORIAL OFFICE
Medical Life

CONTENTS

1. Discuss the origin of the Medicine Man:

Aboriginal man could not grasp the conception of natural death. Disturbance or stoppage of physical life was due to supernatural causes—to the wrath of the dead, the uncanny powers of human enemies, the revenge of offended spirits. Terrifying as were the crocodile and hyena, he could see them and understand them and cope with them, but against witchcraft he had no weapon. Disease-demons were more numerous than the leaves of the forest, and they pursued him every moment of the day and night. He could escape the long serpent that awaited him, but not the ghosts and their magic. Though he climbed the tallest trees or dived in the deepest water, though he hid in the darkest caves or ran till he could run no more, the ghosts never left him—they were in the food he ate, in the water he drank, in the air he breathed. He must be infinitely careful, for without intention he might arouse the wrath of the swarming disease-demons. It was too much for him, he could not fight the ghosts alone, he must have protection. He realized his most important duty was to guard himself against witchcraft, to oppose the magic of his enemies with the superior magic of his friends. Out of primitive man's need, thus arose the first professional class—antedating even prostitution, and older than any religion—the profession of the magician or mystery-man, the Medicine Man.

2. Discuss prehistoric trepanation and its indications:

By far the most important phase of prehistoric surgery was the operation known as trepanation—the removal of part of the skull vault. Trepanned skulls have been found in considerable numbers, and modern surgeons who have attempted to repeat the procedure with a flint knife or shark's tooth have not entirely succeeded. Some of these primitive skulls show scratches around the circular or oval hole, indicating an inexperienced operator, but many of the trephinations have been performed with consummate skill. Evidence of cicatrization or healing is frequently apparent, and many of these skulls have been perforated several times, demonstrating not only that patients survived this ordeal —which must have lasted at least an hour—but submitted to it again.

There is much about trepanation which we do not yet know:

whether the operation was performed by boring, sawing, scraping, cutting or chiseling, or by a combination of these methods; why the larger openings are frequently accompanied by smaller ones nearby; and why the female skulls are marked by intersecting depressions or grooves (the *sincipital-T*). The disks of bone removed by trepanation were valued as amulets (*rondelles*), and were often polished into various shapes and worn as a protection against disease—one of the earliest forms of prophylaxis. Charms from those who survived trepanation were especially in demand, and after the death of these individuals their skulls were chipped into rondelles; if the demand was greater than the supply, amulets were slyly forged from other skulls or from the antlers of stags—primitive man was not too primitive to show his human nature. The chief indications for trepanation were infantile convulsions, relief of cerebral tension, cranial injuries, headaches, epilepsy and blindness. The object of the perforation was to give the confined demon an opportunity to escape.

3. Describe the finding and contents of the Papyrus Ebers:

For ages an unread manuscript reposed between the legs of a nameless mummy—but those shriveled limbs guarded a possession beyond all price. Fortunately, a German scholar was troubled with disturbances of vision, and was traveling in Thebes for his health. But even if Georg Ebers had defective eyes, he saw what the rest of the world had overlooked. He found the neglected manuscript which unrolled the veil of ages and enabled the nineteenth century to peer into the cradle of civilization. Compared with ancient Egypt, "the glory that was Greece and the grandeur that was Rome," belong to yesterday. Seventeen centuries separate us from Galen, but the sands of thirty-four centuries have passed since the Papyrus Ebers was a plant growing carelessly in the Nile—unmindful that its pages would transmit the record of Egyptian medicine to modernity.

Seven hundred remedies are mentioned in the Papyrus Ebers, and some of these drugs are serving mankind today: opium, indisputably the monarch of drugdom; castor oil, which in spite of a hundred rivals, remains the most valuable of cathartics; copper salts, indispensable in ophthalmology—and such familiar drugs as squill, acacia, calamus, coriander, saffron, hyoscyamus, colchi-

cum, gentian, pomegranate and olive oil, and the salts of various metals.

But although the Egyptians used these drugs, as a rule they did not know their specific indications, and they laid just as much stock—perhaps more—in such agents as fly-specks scraped from a wall, and moisture from a pig's ear. Seven hundred remedies are perhaps too copious a materia medica for an early people to employ with discrimination, and the Egyptians seem to have collected drugs somewhat in the spirit that a child collects toys: they took whatever they could lay their hands on, whether they had any special use for it or not. But it was their glory to have stumbled on a few drugs which will last as long as their pyramids.

4. Give evidence of the medical supremacy of Egypt:

Egypt was the medical center of the ancient world. The Biblical admission, "And Moses was learned in all the wisdom of the Egyptians," indicates the origin of Mosaic magic; and even the sarcasm of Jeremiah, "Go up into Gilead and take balm, O virgin daughter of Egypt: in vain dost thou use many medicines; there is no healing for thee," reveals that Egypt was noted for numerous remedies. Homer sang of "Egypt teeming with drugs, the land where each is a physician, skillful beyond all men." Herodotus described Egypt as the home of specialists: "Medicine is practised among them on a plan of separation; each physician treats a single disorder, and no more; thus the country swarms with medical practitioners, some undertaking to cure diseases of the eye, others of the head, others again of the teeth, others of the intestines, and some those which are not local." Diodorus Siculus explained: "The whole manner of life in Egypt was so evenly ordered that it would appear as though it had been arranged according to the rules of health by a learned physician, rather than by a law-giver." Cyrus of Persia sent for an Egyptian oculist to take care of his sick mother, and the body-physician of Darius likewise came from the Nile.

5. Who is the Father of Medicine? Why does he deserve this title?

Medicine, in the enlightened sense of the term, originates in the Periclean age with Hippocrates. Medicine existed for centuries before Hippocrates, and Hippocrates himself wrote a treat-

ise entitled *On Ancient Medicine,* but we properly call him the Father of Medicine for the following reasons: By demonstrating that disease was not dependent upon supernatural causes, Hippocrates emancipated medicine from the gods; by his case-histories and bedside teaching, he founded clinical medicine; by his insistence, "Nature heals; the physician is only nature's assistant," he gave to medical practice its cardinal doctrine of *vis medicatrix naturae;* by discarding polypharmacy and drastic measures, and treating his patients with such "modern" procedures as proper diet, fresh air, change of climate, and physiotherapy, he made medicine rational; by reporting his failures as well as his successes in treatment, he set a standard for all physicians to follow; by his critical attitude toward potent drugs, he inaugurated an era in pharmacology; by the principles in the Hippocratic Oath, he gave medicine its ethical basis.

6. Discuss the work of Hippocrates on prognosis:

The treatise *On the Prognostics* will always be famous for the Hippocratic description of the signs of approaching death which we still call *facies Hippocratica*: nose sharp, eyes hollow, temples sunken, ears cold and contracted with their lobes turned outwards, skin tense and parched, face discolored, eyelids livid, mouth open, lips loose and blanched. There are valuable discussions of pain, fever, headache, pus and urine. The remarkable observation —"A swelling in the hypochondrium that is hard and painful is very bad, provided it occupies the whole hypochondrium; but if it be on either side, it is less dangerous when on the left"—is interesting as the first reference to appendicitis.

7. What were the leading achievements of the Alexandrian School?

Physiology, the first of the experimental sciences born of medicine, was cradled in Alexandria—but drew its sustenance not from Egypt, but from Greece. During the five centuries that this medical center existed, any doctor was proud to claim he had been educated at Alexandria. Several of these pupils acquired fame, though none of the Alexandrians approached in importance the founders of the school—Herophilus and Erasistratus. These two physicians stand out as the first who publicly dissected the human body—and it has been whispered down the

ages that the Ptolemaic zeal for science furnished condemned criminals to these investigators who were thus enabled to supplement dissection with vivisection. Herophilus knew the difference between arteries and veins and understood the unique nature of the pulmonary artery, distinguished the nerves of sensation from those of motion, described the mesenteric vessels and many organs including the prostate gland, named various structures including the duodenum, noted the chyle and lymph, and in his studies of the brain discovered the venous sinuses, the calamus scriptorius, and the torcular Herophili. The work of Erasistratus is more physiological in character, and he concerned himself with such problems as muscular action producing movement, the superior intelligence of man as manifested in his deeper cerebral convolutions—he described the cerebrum, cerebellum, cerebral ventricles and meninges—the ultimate division of veins, arteries and nerves, the method of anastomoses, the closing of the trachea by the epiglottis, the cause of the pulse, hemorrhage, paralysis, and the processes of digestion, nutrition and secretion.

8. Who was the Father of Materia Medica and what did he describe?

In the sense that Hippocrates is the Father of Medicine, and Theophrastus the Father of Botany, Dioscorides is the Father of Materia Medica. Dioscorides came from a province in Asia Minor, and spoke Greek with an accent, but he wrote so clearly that many of his descriptions of ancient plants enabled these plants to be recognized in modern times. His work on materia medica is a limitless storehouse from which all subsequent ages have drawn information. In his day—the first century, A.D.—Greek medicine had been transplanted to Rome, and Dioscorides seems to have been an army surgeon in the service of Nero. In this capacity he traveled extensively, and everywhere was on the lookout for medicines.

Opium was known long before his time, but Dioscorides was the first who distinctly praised it. He pointed out that it allays pain, induces sleep, is useful in chronic coughs, and in overdoses occasions a deep and terrible lethargy. He distinguished the juice of the capsules from the extract of the entire plant, and described how the capsules should be incised. He explained how

to prepare lard for medicinal purposes, and his method of preparing elaterium has been only slightly modified in recent times. He knew the therapeutic applications of linseed, and gave the technic of making vinegar of squills. He was the first to mention ginger, aconite and ammoniacum, and the first who discussed the therapeutics of aloes. He gave mercury its name of hydrargyrum, or fluid silver. He recommended aspidium for tapeworm. He refers to the astringent properties of iron, and advocated its use in uterine hemorrhage. He knew also that all oaks are astringent. He was the first who indicated means for detecting adulteration in drugs. An enthusiastic student counted 958 remedies in Dioscorides, and of course he overlooked some.

9. Describe Galen's work in myology and osteology:

Today, whoever speaks of anatomy, pays tribute to Galen; the *platysma myoides,* says the modern anatomist, but this muscle was first named and described by the Pergamene physician. The frontalis muscle, the popliteus, the two muscles of the eyelids, the six muscles of the eyeball, the muscles of the spine, the muscles of each lateral cartilage of the nose, the maxillary group of muscles, with many muscles of the head and neck, both extremities and the body proper, were comprised in the Galenian myology, and in many instances the names which he suggested have been retained unto the present time.

He divided the vertebrae into cervical, dorsal and lumbar, and gave a correct account of the number and the situation of each. He named the bones and sutures of the cranium, and knew the squamous, styloid, mastoid and petrous portions of the temporal bones; the sphenoid, the ethmoid, the malar, the maxillary and nasal bones were familiar to him. In these descriptions Galen made few errors. The moderns have made little change in his osteology.

10. Write about the Founder of Experimental Physiology:

Hellenic culture, disappearing beneath the heel of the Roman soldier, was able in its decline to produce a physician in whom is summed up the climax and the downfall of classic antiquity. In Galen's time, human dissection was no longer permitted, and

the only human skeletons in existence were two specimens preserved in Alexandria. It was a symptom of the coming doom, that scientific research was already hindered. Galen laid the foundations of his anatomical and physiological knowledge by attending the wounded gladiators and dissecting the Barbary ape. Despite numerous errors, his discoveries in morphology are amazing, as is attested by the structures which still bear the names he gave them. Galen was not content with observation, and he instituted many analytic experiments, particularly of the nervous system. He noted that a longitudinal section of the spinal cord in the median line does not interfere with motion, since the motor fibres do not cross the cord; he followed this with a series of cross-sections severing the cord between each of the vertebrae, and segment after segment revealed information which has become a permanent part of medicine. Primarily a clinician, Galen ranks as the founder of experimental physiology.

With the passing of Galen at the end of the second century, Graeco-Roman medicine expired in Byzantium.

11. Describe some of the contributions of Rhazes to medicine:

The writings of Rhazes contain ingenious and acute observations on topics ranging all the way from hiccough and purgatives to spinal injury and embryotomy. He knew that the pupil contracts to light, and that the remedy for pediculosis of the eyelids is mercurial ointment. He urged the use of cold water in inflammatory fever, and insisted that fever be treated according to its causation. He taught that jaundice was caused by obstruction of the bile-passages, he knew the perils of miasmata, he realized that the nerves of sensation and of motion may be affected separately. He described an instrument for the removal of foreign bodies from the esophagus, and invented a lead cathether which he preferred on account of its flexibility.

European students of Arabian medicine credit Rhazes with having given a fuller account of curvature of the spine, and of the principles of catheterism, than any other author up to his time; he is further credited with being the first who wrote an entire book on pediatrics, the first who introduced chemical preparations into practice, the first who described spina ventosa, the first who maintained that disorders of the bladder are accom-

panied by hematuria, and the first who employed certain urethral injections.

The classic exposure of quacks is Rhazes' spirited account, and any sketch of the great Persian would be incomplete without it.

The text-books of an age are much alike, and when Rhazes opened his *Division of Diseases* by first enumerating the maladies of the head, gradually descending to those of the feet, he was simply following the prevalent but unscientific fashion. But Rhazes wrote a slender *Treatise on Smallpox and Measles,* and here he followed no one. Before Rhazes, the references to pox were of the vaguest sort, but Rhazes placed this disease on the medical map. His description stands out as unrivaled—the original and still surviving landmark in smallpox. For once, an Arabian touched hands with Hippocrates and Aretaeus. It is not his bulky *Continent,* but his tract on *Smallpox and Measles* which makes Rhazes a pathfinder in medicine.

12. Discuss the status of cancer among the Greeks and Arabians:

The Hippocratic school looked at a growing malignant tumor, and was reminded of a moving crab (*karkinos, karkinoma,* cancer). Galen explains, "Just as a crab's feet extend from every part of its body, so in this disease the veins (he did not know the lymphatics) are distended, forming a similar figure." Paulus repeats the comparison, and adds, "But some say that cancer is so called because it adheres to any parts which it seizes upon in an obstinate manner like the crab." The masterly description of Celsus ends with the melancholy reflection that nothing can be expected from medicines or corrosive applications or burning irons or the scalpel. The Arabians received their knowledge of malignancy from the Greeks; like their teachers, they sanctioned operation in cancer of the breast and extremities, and realized it may be extirpated only in its initial stage—and what more do we know of this frightful malady to-day?

13. Describe Leonardo da Vinci's contributions to anatomy:

Leonardo is the first who drew the human skeleton—the drawings of his predecessors are too contemptible to be considered—and his portrayal of the curvature of the spinal column is as much

a masterpiece as the Leonardesque smile. His figures of the muscles, supplemented with philosophical studies of muscular movement, cannot be surpassed. His dissections and delineations of the heart and the cardiac vessels resulted in many discoveries, including the little bundle known as the intraventricular moderator band. The fetal opening between the heart's auricles usually closes, and Leonardo was probably the first investigator to note a persistent foramen ovale. He devised casts with valves, made of glass, to illustrate the action of semilunar valves; by injecting melted wax into the brain which he removed from the cranium, he was the first to obtain impressions of the cerebral ventricles; and he was the first to employ cross-sections, now so indispensable in anatomy. Only Leonardo could have given us such masterly drawings of the generative organs and their blood supply, of the position of these organs during coitus, and of the child in the womb. His work on the mechanism and dynamics of the body, on surface anatomy and morphological relationship was without parallel.

14. Name some of the discoveries of Vesalius:

Andreas Vesalius made so many discoveries that it is difficult to name them all. His researches on the vascular system were of extreme importance; he determined the position, form, and internal structure of the heart, and investigated the function of its fibers and valves. Among his other descriptions and discoveries may be mentioned a fuller account of the anatomy of the brain than had yet appeared; the first satisfactory description of the medical student's terror, the sphenoid bone, at the root of whose pterygoid process is a small aperture still called *foramen Vesalii;* the discovery of the canal which passes in the fetus between the umbilical vein and the vena cava. He showed that the sternum consists of three parts, and the sacrum of five or six. He was the first who described the omentum and its connection with the stomach, spleen and colon; the internal pterygoid muscle, the ductus venosus, the course of the vena azygos and subclavian vein, the absence of the "rete mirabile" in the brain, the five cerebral ventricles, and the non-glandular character of the caruncles. He likewise described accurately the mediastinum and pleura, the tensor tympani muscle, the labyrinth, the vestibule of the ear and the long process of the malleus, the fornix and septum, and

he was the first whose views on the pylorus have been found correct.

15. Give some concrete examples of the long dominance of Galenism:

The life of Vesalius was a struggle against the hypnotic effects of Galen's authority. If Galen had said that a kidney is larger than the liver, men would have believed it. For example, Galen had written that our thigh-bones are curved. Now, when even a cursory examination revealed the fact that our thigh-bones are straight, Sylvius still asserted that they were curved in a state of nature, and that their straightness was due to the narrow trousers which men wore. Galen had declared that man (irrespective of age) possessed an intermaxillary bone. Vesalius could not find it, and he said so—he who could tell every bone in the human body blindfolded. But the Galenists refused to be convinced. A human skeleton was brought to Sylvius. "Where is this intermaxillary bone?" he was asked. The faithful Galenist answered angrily, "Man had this bone when Galen lived. If he has it no longer, it is because sensuality and luxury have deprived him of it." Galen also said there is a connection between the two ventricles, and thereafter every anatomist who examined the heart saw the hole. Then Andreas Vesalius looked, and said. "I don't see it." And he didn't—it isn't there.

16. Describe the significance of Vesalius:

Amid the intense activity of the Renaissance—when not only imposing folios but any minor tract that issued from the printing-press of Aldus or Frobenius or Oporinus might contain a new viewpoint or a discovery opening the road to further discoveries —it would not be surprising if it proved difficult to choose the outstanding contribution. Yet the selection is not only simple but inevitable, for one landmark overtowers all others, remaining as the foremost achievement of the medicine of the sixteenth century. By his observations as physician and surgeon, by the dissection of corpses stolen from graveyards and gallows, and by public demonstrations on the cadaver in Italian universities, a youth of twenty-eight reconstructed our knowledge of the human body. A great many examples of anatomical drawings, prior

to 1543 have come down to us; with the exception of Leonardo da Vinci's wonderful but hidden sketches in red chalk, all pre-Vesalian anatomical illustrations—irrespective of the century, or whether of Oriental or European origin—are fearfully wooden and alike; whether representing the external structure, or the viscera, osseous, muscular or nervous system, they bear a startling resemblance to the pictures which a youngster is apt to make with his first pencil. The change wrought by Vesalius is the dividing-line between the old and the new. His accurate and magnificent illustrations, the number and significance of his discoveries, the completeness of his descriptive anatomy, often with the applied physiology, his demonstration of the value of the experimental method—resulting in the overthrow of Galenism—combined with the impetus he gave to other investigators, make the *Fabric of the Human Body* the cornerstone of those sciences which deal with tissue.

17. What was Paré's boast, and how was it finally wiped out?

Paré was not one of those who minimized the results of their own labors. "God is my witness," he says, "and men are not ignorant of it, that I have labored more than forty years to throw light on the art of surgery and to bring it to perfection. And in this labor I have striven so hard to attain my end, that the ancients have naught wherein to excel us, save the discovery of first principles: and posterity will not be able to surpass us (be it said without malice or offense) save by some additions, such as are easily made to things already discovered."

Truly a bold prophecy, which we must challenge. Let us look at it fifty years after it was made: is it true? Yes, true. One hundred years later—and the proud words cannot be gainsaid. Still fifty years, and still the prediction cannot be controverted. Two hundred years pass—what now? Bravo, Paré, after two centuries to be still in the van! Another fifty years roll by—what then? What then?—why, antiseptics and anesthetics are discovered, and Paré's boast is utterly wiped out. Scratch out his passage with a triumphant hand. We surpass him a thousand times and more! That which he never even dreamed of in his most buoyant mood has been accomplished in reality.

Ambroise Paré is no longer on the skirmish line of surgery,

fighting the advance battle for the alleviation of suffering. But though his children have gone so far beyond him, they follow the trail that he broadened and blazed, and Ambroise Paré ever remains the beloved Father of Modern Surgery.

18. Describe the advance of materia medica in the seventeenth century:

Although all the excreta of all the animals retained their honored places in the pharmacopeias of the period, the materia medica was enlarged by the introduction of numerous remedies which have a more modern sound: benzoic acid was described by Blaise de Vigenere, sulphate of potash by Oswald Croll, tartar emetic by de Mynsicht, calomel by Beguin and de Mayerne, ipecac by Piso and Helvetius, black cohosh by Plukenet, cowhage by Parkinson, pareira brava by Pomet, calumba by Redi, star-anise, vanilla, and gamboge by Clusius, tartrate of potassium by Lemery, Iceland moss by Borrich and Hjarne, cascarilla by Stisser, serpentaria by Thomas Johnson, petroleum by de la Roche d'Allion, acetate of mercury by Lefebure; cinchona, catechu, jalap and lycopodium were introduced into Europe; Nehemiah Grew discovered magnesium sulphate in Epsom waters, Glauber discovered sodium sulphate and zinc acetate, Padre Acugna discovered oil of copaiba, Brandt discovered phosphorus, and Sala discovered the method of preparing silver nitrate.

19. Describe the significance of the discovery of the circulation of the blood:

In the early years of the seventeenth century, the fellows of the Royal College of Physicians who attended the Lumleian lectureship in surgery, saw before them a small, young, raven-haired man. They heard him read rapidly from his notes in his very bad handwriting: "It is plain from the structure of the heart that the blood is passed continuously through the lungs to the aorta as by the two clacks of a water bellows to raise water. It is shown by the application of a ligature that the passage of the blood is from the arteries into the veins. Whence it follows that the movement of the blood is constantly in a circle, and is brought about by the beat of the heart." Thus William Harvey announced the most important physiological discovery in the history of medi-

cine. He allowed twelve years to elapse before publishing, in 1628, his *Anatomical Disquisition on the Motion of the Heart and Blood.* Harvey had sagacious forerunners from Galen down to Realdo Colombo, and his teacher Fabricius taught him that the venal valves are always directed toward the heart, yet in comparing their work with his we realize that while his predecessors groped for the truth and advanced stumblingly, he understood clearly and demonstrated superbly. The dramatic feature of his discovery is the impression of a circuit moving uninterruptedly within us; instead of pools of stagnant blood, we now conceive of a continuous life-stream. With this conception began the reading of the cryptograms of function—the heart beat, tissue changes, metabolic processes, glandular activity, blood transfusion, the mechanism of respiration—and physiology as a working science came into being.

20. How was the capillary circulation discovered?

The riddle of respiration had puzzled philosophers at least since the days of Aristotle, and surely it is interesting to know how we breathe. Many of the acute minds of the mid-seventeenth century—Boyle, Hooke, Lower, Mayow, and Borelli—tackled this problem, and in 1660 it became the object of Malpighi's inquiry. Up to this time the lung had been regarded as a sort of porous parenchyma—Fabricius compared it to tow—and it was believed that somewhere within its substance the smaller divisions of the pulmonary artery lost themselves, pouring out their blood into the open spaces, where it was later gathered up by the pulmonary veins, while the minuter parts of the windpipe were also supposed to terminate in this fleshy tissue. But now, with the aid of his lenses and the lungs of a dog, a tortoise, and a frog, Malpighi began that series of observations which has caused him to be regarded as the greatest of microscopists and the founder of histology.

He showed that instead of a perforated mass in which the blood was poured and then sucked out, the lung was vesicular in nature, the bronchi being continuous with the air vesicles, the air and blood of the lung never actually in contact, but separated by a membrane, and that the blood was constantly within channels, even when crossing from the arteries to the veins—for he

observed the capillary circulation. This momentous discovery bridged the one remaining gap in the Harveian hypothesis—for Harvey could never explain where or how the interchange occurred between arterial and venous blood.

21. Describe Malpighi's work on the chick:

Malpighi next turned his sagacious eye upon the chick. Now the chick is an humble creature—the barnyard is its home and a worm its delicacy—but Malpighi made the chick famous: with it he created the science of embryology. He floated off the embryo in water and spread it on a glass slide, viewing the developing organs under his microscope. He described the changes he observed hour by hour. He saw and drew the formation of and closure of the medullary groove, the primitive metameres, the formation of the cerebral vesicles, the appearance of the optic vesicles with their stalk, the development of the heart from a single bent tube to the arrangement of auricles and ventricles and aortic arches—and generation after generation of medical students have followed his eye and drawn as he has drawn. In 1672 Malpighi sent this work, in two parts, to the Royal Society —*De Formatione Pulli in Ova,* in February, and *De Ova Incubatio,* in October. When the Fellows read it, they read the life-history of the chick: from the beginning until it is hatched, from the time that "the little opaque spot in the egg grew into a living, breathing, feathered bird."

22. Discuss the influence of the Paris Faculty in the seventeenth century:

The Paris Faculty excluded surgery from the curriculum, and pursued with incredible malignity, every one who dared suggest that surgery was of equal rank with regular medicine; it expelled, with bitter rancor, any member who prescribed the new drugs, such as antimony, cinchona and ipecac; it railed at Servetus because of his rational treatise on syrups; it announced, when the Collected Works of Ambroise Paré were translated into Latin by his able pupil and son-in-law, Jacques Guillemeau, that as no one but themselves were capable of writing Latin, it was over-presumptuous for surgeons to attempt such a thing, and it was decreed that this edition be torn up and kept for a vile purpose; not only did it

forbid Harvey's demonstration of the circulation of the blood to be taught, but it opposed Pecquet's discovery of the thoracic duct, and denounced Aselli's discovery of the lacteals.

The Paris Faculty was consistent in refusing to recognize any discovery or to permit experimentation. The Paris Faculty believed in interminable discussions and not in demonstrations, and when the candidate—after infinite mental torture—finally received the cap and accolade, he was a full-fledged doctor, but had never seen a patient. Under its auspices, medicine marched backward to the Dark Ages. What would have happened, had it not been for the genius of Molière? More than any other factor, the laughter of Molière was the savior of medicine in the seventeenth century.

23. Discuss Haller's most famous experiments:

Haller's versatile genius revealed itself best in physiology: grappling with Glisson's conception of irritability—the quality by which living matter responds to stimulus—Haller engaged in many vivisections, "undertaken with great reluctance in the hope of benefiting the human race"; cutting the nerve connecting the spinal cord with a muscle, he demonstrated the muscle's capability of contracting without receiving the hypothetical animal spirits from the brain. These experiments proved: irritability is not dependent upon sensibility; irritability is the specific property of muscular tissue and sensibility is the specific property of nervous tissue; muscle exhibits irritability when excised and separated from its nerve supply, hence inherent muscular force is differentiated from inherent nervous force. The animists and vitalists were alarmed, and the new doctrine seemed irreligious in spite of Haller's known piety; after the discussions were over, the old views passed away, and Haller's classification entered physiology.

24. Discuss the work and fate of Caspar Friedrich Wolff:

In 1759, a student of twenty-six, a Berlin tailor's son working for his doctorate, attacked the preformation doctrine in his thesis, *Theoria generationis,* which he dedicated to Haller, whom he called "glorious man." Haller was polite, but remained convinced of preformationism. The thesis advanced the doctrine of epigenesis, which had been foreshadowed by Aristotle and Harvey—it

maintained that the organs of the embryo do not unfold and enlarge from invisibility, but that there is a progressive formation and differentiation of organs. Between Haller, potentate of physiology, and this unknown Caspar Wolff, there could be no argument. Haller simply laughed, and no one read the young doctor's thesis. There was no room in Germany for Wolff, and he accepted an invitation to Russia where he spent the last thirty years of his life. Oddly enough, Caspar Friedrich Wolff found peace under the turbulent Catherine the Great. At St. Petersburg he produced his great memoir on the development of the intestine (1768), which was also neglected; when the younger Meckel finally translated it into German, he had to wipe from its covers the dust of many years. So effectually was the light of Caspar Wolff quenched by the Hallerian snuffers that today not a single portrait of the discoverer of the Wolffian bodies is extant. Caspar Wolff is now "justly reckoned the founder of modern embryology." So the moral of this story is: in science the young son of a tailor may be right, while all his contemporaries, including the most famous physician of the age, are being led astray by preconceived theories.

25. Discuss Spallanzani's work in digestion:

Spallanzani is one of the great names in physiology. His early idleness was replaced by an incessant and effective activity. In his experiments on digestion, he swallowed linen bags containing food, perforated wooden tubes, and was enough of a scientific martyr to obtain gastric juice by making himself vomit on an empty stomach. He supplemented his self-experimentation by experiments on a surprising variety of animals. Spallanzani confirmed and extended Réaumur's work by pouring gastric juice, drop by drop, on meat and bread, demonstrating it dissolved foods in a test-tube as readily as in the body. Some beautiful theories died when the stomach ceased to be regarded as a churning-mill, mechanically grinding food by muscular force, and digestion was seen to be neither coction, trituration, putrefaction, nor fermentation. The eighteenth century learned, through Réaumur, Spallanzani, and Eduardus Stevens of Edinburgh, that digestion is the result of the solvent power of the juice manufactured by the stomach.

26. For what is Withering noted?

The most important addition to the materia medica of the eighteenth century was digitalis—"the opium of the heart." For the correct use of this drug—the most valuable since the discovery of cinchona—medicine is indebted to William Withering's *Account of the Fox-glove* (1785). Withering confesses that he received his hint of the value of digitalis from an old woman's recipe. The expression, "old woman," in a medical sense, is usually a term of reproach, but two essays could be written: one, on the pernicious influence of old women in medicine; and another, on the beneficial influence of old women in medicine. Withering was a consumptive who did admirable work in half a dozen branches of science. As this gifted botanist lay on his death-bed, some one uttered this unforgettable phrase: "The flower of physicians is indeed Withering."

27. Name the landmarks in electricity in the eighteenth century:

The outstanding event in electricity of this era, was the experimental demonstration of the identity of lightning and the electric spark. This discovery was accomplished in a thunderstorm, by means of a silk handkerchief, a key and a kite—but it was the hand of Benjamin Franklin that held the kite. The practical-minded Franklin was not content merely to draw the electric fire from the heavens; he provided himself with a static generator, opened a clinic on Green Street, Philadelphia, and inaugurated medical electricity in America. Franklin's final comment on the electrotherapy of his day was remarkable for its candor, sagacity, and lack of laudatory testimonials. Toward the end of the century, Luigi Galvani, while working in his laboratory on frogs, was prepared to stumble on the electric properties of excised tissues, and in the last year of the century, his countryman, Alessandro Volta, built that enduring monument, the Voltaic Pile.

28. How did Hunter's Canal receive its name?

John Hunter discovered much: he was forever experimenting. He had the privilege of making experiments on the deer in Richmond Park, and once he caught a buck and tied one of its external carotid arteries; he was not perplexed when the half-grown antler.

which had received its blood-supply from the imprisoned vessel, became cold to the touch. But a week or two later, when the wound around the ligated artery healed, Hunter again examined the antler and was surprised to observe that it had regained its warmth and was growing. Thinking that perhaps the artery had not been sufficiently bound, Hunter killed the buck to ascertain if this was really the case, but he had done his work well: he found that the external carotid was tightly secured. But he found also that certain small branches of the artery, both above and below the ligature, had enlarged and by their anastomoses had restored the blood-supply of the developed antler. "Oho," said Hunter. "I see that under the stimulus of necessity the smaller arterial channels quickly increase in size to do the work of the larger. I must remember that."

Not many months later there lay in St. George's Hospital a patient who was looked upon as doomed: either he would succumb to popliteal aneurism, or he would perish under the surgeon's knife, for few who underwent this operation lived to undergo anything else. So frequently fatal was this operation that the profession began to adopt Percival Pott's method—amputation of the limb above the tumor. But the physician in Hunter revolted against this idea of mutilating a man. He never regarded an operation a success if the patient rose from the operating-table a cripple. Hunter thought of his experiment with the buck—recalled that when the passage through a main trunk is arrested, the collateral vessels are capable of continuing the circulation; if, he wondered, far from the seat of the disease he fettered the artery in the sound parts where it is tied when amputation is performed, would not the absorbents be able to cope with the tumor? So in the lower part of its course in the thigh, in the fibrous sheath since known as Hunter's Canal, he ligated his patient's femoral artery. In six weeks the patient left the hospital, walking on the legs that Nature gave him and that Hunter saved for him. And following in his path, on healthy limbs, have trod thousands of men, rescued from deformity or death by this discovery of John Hunter.

29. Describe the importance of Jenner's work:

Almost at the end of the eighteenth century, a green-covered quarto was presented to the profession: it contained the picture

of a dairymaid's hand, three engravings of arms, and not more words than make a small pamphlet, yet it proved effective to conquer a chronic plague which in the eighteenth century alone wiped out sixty million human beings. Edward Jenner's *Inquiry into the Causes and Effects of the Variolæ Vaccinæ* demonstrated preventive vaccination against smallpox—and this drop of variolous pus has expanded into the far-reaching science of Immunology. Many triumphs of medicine are written in that word, and it uncloses ever-widening vistas to biology. His book contains also the first reference to anaphylaxis.

30. What was the phlogistic theory and who destroyed it?

This doctrine which was introduced by Johann Joachim Becher and championed by Georg Ernst Stahl had special reference to the alterability of substances by fire. Its essential feature consisted in assuming that all matter which could burn was a compound, containing at least two constituents. On combustion, one of these remained behind and one escaped. The element which remained was named calyx, the principle which disappeared was called Phlogiston. It corresponded somewhat to the "celestial heat" of earlier chemists. Since this Phlogiston existed in all combustible substances and always vanished on heating, it was believed that every time a substance was burned it grew lighter.

In due time it began to be pointed out that some substances when heated, instead of becoming lighter, became heavier, and that often the products of combustion weigh more than the substances burned. It was shown that when zinc is burned, it changes into a white powder which is heavier than the original metal.

Lavoisier knew that when phosphorus burns, the acid body formed by the combustion weighs more than the phosphorus did. But it takes a long time for a naked fact to destroy a theory intrenched in argument, and defended by dialectics. Yet already the casket of Phlogiston was being prepared, and Lavoisier was the immortal undertaker.

Oxygen was discovered by Priestley and Scheele, nitrogen was found by Rutherford, the air was analyzed by Cavendish, and a great light illumined the mind of the French chemist, and the death knell of the doctrine of Becher and Stahl was rung. Hither-

to, combustion was thought to be due to a chemical decomposition in which Phlogiston escapes, but Lavoisier now accounted for the phenomenom of combustion by chemical combination, oxygen or another element being taken up.

The cover was ready to be nailed to the coffin. And the talented wife of Antoine Laurent Lavoisier—Liebig has told us so—robed as a priestess, committed to the flames on an altar, while a solemn requiem was chanted, the phlogistic system of chemistry.

31. How was the "vital force" theory demolished?

Friedrich Wöhler had received his M.D. at Heidelberg, and intended to prepare himself for medical practice, but Leopold Gmelin—the most famous of the many Gmelins who cultivated chemistry—persuaded him to see Berzelius, and thereafter Wöhler never touched a lancet. In the annals of chemistry, the name of Wöhler logically follows Gmelin and Berzelius, for in 1817 Gmelin said it was characteristic of organic compounds that they could not be produced from their elements, while Berzelius in 1827 wrote that "the elements present in living bodies obey laws totally different from those which rule inanimate nature." In the following year, Wöhler, still in his twenties, accomplished what every chemist had deemed impossible: he created an organic substance from its inorganic elements. Wöhler's preparation of urea demolished the barrier between the organic and inorganic world—and built a bridge instead. He cremated the vital force theory, and from its ashes arose a new conception of the unity of matter. He overthrew an ancient dogma, and cleared the way for the laboratory preparation of complex mineral and vegetable products. Wöhler began with the synthesis of urea, Emil Fischer ended with the synthesis of proteins from their amino-acid constituents, and in this field chemists of the future have only one more problem to solve—the synthesis of albumin, which is protoplasm, which is life!

32. Describe Laennec's early discoveries:

Within the mesh of Parisian gaiety many a youthful student from the provinces has been lost, but Laennec had come for the college curriculum, and the world of merriment had no meaning for him—although he could dance and write verse and play the

flute. He soon became connected with the Journal of Medicine, a periodical which he eventually edited, but which in those days was conducted by Corvisart, Leroux and Boyer.

Two years after his arrival in the French metropolis young Laennec had a reputation, for in his twenty-first year he gave to medicine its first satisfactory description of peritonitis. Among his other early accomplishments were his minute reports of four hundred cases of disease, and his original accounts of the subdeltoid bursa and the fibrous capsule of the liver. No one seemed to know so much about the tunics of organs as did Laennec.

The passing years still found Laennec in the dissecting-room, and here he saw the conditions which he designated melanosis, and the post-mortem wart. Laennec's catarrh, Laennec's perles, Laennec's cirrhosis, Laennec's thrombus, and Laennec's râle are some of the monuments he erected along the pathological highway. To him we are indebted for the standard pictures of such diseases as bronchiectasis and esophagitis, and among the permanent additions to our nomenclature are several terms of his devising, such as ægophony and pectoriloquy.

33. Describe the discovery of the stethoscope:

In 1816, Laennec was transferred to the Necker Hospital. During this year a woman who was suffering from heart trouble consulted him. Laennec questioned her, but was puzzled how to proceed with the examination. There was no use in thumping her thorax, for the patient was too stout; neither could he put his ear directly upon her breast, for she was still young. We may argue that physicians have privileges, but Laennec himself claims that immediate auscultation was inadmissible. In his dilemma he happened to recollect a fact in physics. Acting on the idea, he rolled a quire of paper into a kind of cylinder and applied one end of it to the region of the patient's heart and the other to his own ear. This was the first stethoscope. Then René Laennec heard the language of pathology. A diseased heart appealed to him for aid. Injuries that for centuries had been inaudible, now found a voice. A sick organ murmured its tale of woe into the ear of a great and sympathetic physician. Auscultation, the crowning glory of physical diagnosis, came into existence.

34. How was the first Physiological Laboratory established in Europe?

At the University of Breslau, Purkinje stirred up trouble by asking for a microscope. The authorities could not understand why a physiologist needed a microscope, and they sighed for the good old days of Bartels. There was the famous Bartels, becoming a Geheimrat and climbing to the Berlin chair; writing many books on *naturphilosophie,* medicine and theology; diagnosing all diseases with the most learned phrases and knowing enough to denounce such new-fangled notions as Laennec's stethoscope; and yet he never needed a microscope. If this were permitted to go on, the university would be cluttered up with apparatus and specimens, and the students would be occupied in performing experiments instead of reading van Helmont and Haller and Bartels. Evidently the arguments failed to convince Purkinje, for in an unoccupied corner of the college building he opened the first physiological laboratory. Had John Hunter tried to install his Museum in St. George's Hosptal, he would not have aroused more opposition than Purkinje with his laboratory which seemed to his colleagues utterly useless in medicine. Moreover Otto, officious and esthetic, objected strongly to the stench. Purkinje solved the difficulty by transferring the laboratory to his own house, and thereafter he lived and dined and slept in the midst of physiological equipment—including the unavoidable odors. His wife was not supposed to complain, for she was Rudolphi's daughter.

35. Describe the discoveries of Purkinje:

Johannes Evangelista Purkinje's first work was in physiological optics, and thrice he wrote his name in this field: Purkinje's figures, Purkinje's images, and Purkinje's phenomenon. A bibliography of the contributions to these subjects during a century would show how large a number of investigators received their impulse from Purkinje. The work of Purkinje was germinative, for even if it consisted of only a few paragraphs, it proved reproductive. His method of lighting the retina, his measurements of the curvatures of the lens and cornea, his studies of the refracting surfaces of the eye with mirrors, not only anticipated the ophthalmoscope of Helmholtz, but made it inevitable.

The name of Francis Galton is usually associated with the

foundation of finger-print identification, but seventy years earlier (1823) Purkinje wrote: "The wonderful arrangement and design which are on the palm of the hand and upon the sole of the foot, and especially the little hollows on the fingertips, the papillary lines, command our attention." He then proceeded to describe with accuracy the unchanging character of fingerprints, illustrated with various figurations. His pioneer work is of value to all criminologists, and we may well call Purkinje the old master of dactyloscopy.

Most pre-Virchovian workers, including Purkinje, are rather roughly handled in the *Cellular Pathology,* but Virchow credits Purkinje with having devised the term corpora amylacea; he also introduced the terms enchyma and cambium and *protoplasm* and others—almost reminding us of Walther Flemming who in a single year increased the nomenclature of cytology with mitosis, amitosis, karyomitosis, dyaster, karenchyma, net-knot, spireme, mitome, karyoplasm, and interfilar substance. Richard Mead, relying on the experiments of Galen, felt safe in swallowing the poison of vipers, but Purkinje broke new ground in some of his self-experiments with belladonna, camphor, digitalis, opium, stramonium, and turpentine.

Every investigator of the first rank has conducted a host of minor researches, and among Purkinje's innumerable ones may be mentioned: an early paper On the World of Dreams, now over a century old, which should be read to-day in the light of Freudism; the contribution to acoustics On Tartini's Tones; his auscultation experiment, by which he was able to determine the points of rest and motion of a vibrating plate, without employing Chladni's sand; his work on rhizopods, the nautilus, and embryology of the tadpole; his original description of the peculiar formation of the skin of cucumber plants; and his observations of the methods of fertilization in the plant world.

More important investigations, and belonging chiefly, but not exclusively, to his first sixteen years at Breslau, were: his contribution to photometry; his observation that deaf-mutes can hear through the bones of the skull; his experiments upon the production of vertigo which paved the way for the knowledge of nystagmus; his work with Pappenheim on artificial digestion which antedates Schwann, including the demonstration of the dissolving power of acidulated infusion of pancreatic juice; his researches

with Valentin on ciliary epithelial movement and the explanation of its independence of the nervous system; his original descriptions of bone, cartilage, blood-vessels, gastric glands, and special organs; his discovery of the sudoriferous glands and their ducts; of the flask-shaped Purkinjean nerve-cells with their axones and branching dendrites whch form the characteristic features of the cerebellum; and of the Purkinje fibers in the cardiac muscle. In microscopy he was the first to use the microtome, microphotography, Drummond lime light, glacial acetic acid, potassium bichromate, and Canada balsam.

36. Discuss the significance of Claude Bernard:

Claude Bernard's researches were not only significant in themselves, but the methods by which he reached his results stand as guide-posts for future workers. Important as were his discoveries of the glycogenic function of the liver, of the vasomotor system, and of the threefold action of pancreatic juice, momentous as was his insight into the regulation of the blood-supply of the body, his production of disease by artificial means, and his conception that the body not only breaks down chemicals but by building up complex substances performs a physiological synthesis, the name of Claude Bernard is on the lips of present-day investigators, not so much because of these finished achievements, as because the unsolved problems of life and disease and death are approached by the methods he introduced.

The methods of medical research must be learned by all who investigate problems, and yet in the last analysis the method itself is unimportant. No one has stated this better than Claude Bernard, the master of method: "The experimental method cannot give new and fruitful ideas to men who have none; it can only serve to guide the ideas of men who have them, to direct their ideas and to develop them so as to get the best possible results. As only what has been sown in the ground will ever grow in it, so nothing will be developed by the experimental method except the ideas submitted to it. The method itself gives birth to nothing. Certain philosophers have made the mistake of according too much power to method along these lines." Just as one who has learned the technique of prosody and is familiar with the rules of versification may be unable to produce a lyric, so a man may be trained a lifetime in the best methods and principles of

research, and at the crucial moment may fail to recognize a discovery bubbling before him in a test-tube.

Claude Bernard undertook his investigations of South American curare, and found why carbon monoxide is a prompt poison, not because he was working out a method, but because it was the natural, intuitive and inevitable thing for him to do; he followed the chorda tympani and the spinal accessory nerve, he grappled with recurrent sensibility, for the same reason that Schumann in 1840 overflowed with more than a hundred songs. As Paul Bert said of Claude Bernard, "He discovered as others breathed."

37. Discuss the work of Paul Bert:

In these days of swift and multiplying changes, let us not forget Paul Bert—the fiery radical who attacked the frauds of the Church of his day as vehemently as Gambetta assailed that evil spirit, Louis Napoleon. After studying and discarding engineering and jurisprudence, he came under the influence of Claude Bernard, and did brilliant work in physiology. He had an eye for the picturesque, and investigated the movements of the sensitive plant, and the change of color in the chameleon. His elementary texts on scientific instruction, his investigations of grafting and vitality of animal tissues, his work on poisons and anesthetics, on respiration and asphyxia, have been overshadowed by his classic researches on air-pressure.

Paul Bert divided his allegiance between Claude Bernard and Leon Gambetta, and after the statesman's early and accidental death, Paul Bert was sent to Indo-China as resident-general to Annam and Tonkin. Strange that one of the most cultivated men of his generation should go out among the dwarfish areca-nut chewers with their flattened faces. From the curved mountains of Yun-nan to the Song-Koi valley and the Ba-be lakes, science had no existence, but Paul Bert prepared to govern the natives according to the principles of Claude Bernard. The tiger-cat and the wild-boar thrive, but it is not a land for Arab horses and civilized men. Within seven months of his arrival, the far-sighted resident-general lay dead of dysentery in the delta of the Red River. Now at Hanoi the Paul Bert College stands, challenging comparison with the pagoda of the Great Buddha. Let us remember Paul Bert.

38. Discuss Henle's pathological researches:

During Henle's last year in Berlin, his *Pathological Researches* (1840) appeared. In the brilliant essay on fevers he dethroned the archæus of Helmont and the sensitive soul of Stahl, and offered a rational explanation of elevated body-temperature. But the feature of the book was the essay on "Miasma and Contagion," which laid the foundation of the germ-theory of disease, as it contains the first clear statement, in modern terms, that infectious diseases are due to specific microörganisms. Henle said that if these organisms are invisible, it is not because of their extraordinary smallness, but because they differ so little from the tissues in which they are embedded, that they remain unrecognizable. The predictions which Henle made in 1840 were fulfilled, more than forty years afterward, by his pupil, Robert Koch. When the stain was introduced into bacteriology, Henle was hailed as a prophet—but in the Berlin days, when Henle and Hirschwald met for the last time, the publisher complained that the entire edition of *Pathological Researches* was still on his hands.

39. Discuss Henle's genito-urinary discoveries:

Special reference should be made to the urogenital work of Jacob Henle. He discovered cylindric casts in the urine; pointed out that varicocele is almost invariably left-sided; described the expanded outer half of the Fallopian tube, known as Henle's ampulla; the portion of the uriniferous tubule, known as the canal of Henle; the granular mononuclear cells in the seminiferous tubules, known as Henle's cells; the fibrin formed by precipitating semen with water, known as Henle's fibrin; the remains of the gubernaculum surrounding the vas deferens and vessels of the spermatic cord, known as Henle's internal cremaster; and the striated muscular fibres encircling the prostatic and membranous urethra, known as Henle's sphincter. But his most interesting find in this field was the U-shaped turn of the uriniferous tubule which is formed by a descending and an ascending loop-tube, known everywhere as Henle's loop. Concerning this discovery, the fortunate Henle wrote one of his characteristic notes to Pfeufer.

40. Describe Kölliker's work in histology:

Albert Kölliker carried the Schleiden-Schwann cell theory into embryology, being among the earliest investigators to recognize

the ovum as a single cell, and treating segmentation simply as normal cell division. Henle had discovered unstriated muscle in blood-vessel walls, but Kölliker was the first who succeeded in isolating it, and demonstrated that smooth muscle is composed of nucleated muscle-cells. In the seventeenth century, Leeuwenhoek described the spermatozoa, but it was left for Kölliker to explain their true development, and he again recalled Leeuwenhoek when he increased our knowledge of the branched muscle plates of the heart which had first been seen by the Delft microscopist.

Kölliker extended Corti's discoveries in the histology of the ear, and was the first to supply a satisfactory description of the fibrous layer of the substantia propria of the iris. Kölliker's proof that nerve-fibers are continuous with nerve-cells was sufficient to establish an immortal reputation, and it is perhaps in the minute anatomy of the brain and spinal cord that Kölliker accomplished his most valuable work: the neuroglia is known as Kölliker's reticulum, the ganglion-cells are spoken of as Kölliker's tract cells, and the gray matter surrounding the spinal canal is eponymized into Kölliker's nucleus. The journal of zoölogy which he edited for half a century, his treatise on comparative embryology, and his text-books on microscopic anatomy and human histology—the first comprehensive works on the subject—were replete with his unnumbered researches and discoveries.

It has truthfully been said of Kölliker—or von Kölliker, as he became in his age—that "there is no fragment of the body of man on which he did not leave his mark," and that "he knew more by direct personal observation of the microscopic structure of animals than any one else who has ever lived." He was one of the greatest histologists of all time, and one of the chief creators of its modern phase.

41. How was chloroform anesthesia discovered?

On the evening of November 4, 1847, Simpson and his assistants inhaled several substances without any marked effect. Ether still remained the unrivalled anesthetic. At this moment Simpson happened to remember that a Liverpool chemist named David Waldie had spoken to him about a certain heavy colorless liquid. Simpson looked for the bottle, but could not find it. Probably

when he was on the point of remarking that it wasn't of much importance anyhow, the amber-colored bottle was pulled out from the bottom of a heap of waste paper. Simpson scrutinized it again and shook his head dubiously. It seemed to him too ponderous to be of much value.

But he took out the stopper, poured the contents in the tumblers, and the three inhalers eagerly shoved their noses to the brim. They arose, happier than when they had sat down. Keith's eyes grew bright and he laughed heartily, Matthews Duncan waltzed around the room, and Simpson wiggled his toes. Some ladies came into the room—these experiments were conducted in Simpson's dining-room and not in a laboratory—and the gentlemen were remarkably amiable. The delighted ladies did not quite know what to make of it, for they did not understand that the doctors were historically drunk on chloroform. Suddenly the scene changed—Simpson and his crew became confused, lost their senses, and fell to the floor.

When Simpson awoke and made contact with his surroundings, he realized that the usually alert Duncan was snoring, that Keith's legs were attempting to overturn the table, and that he himself was prostrate. His thoughts were as follows: "This is better than ether." One of the young ladies, Miss Petrie, wishing to prove that she was as brave as a man, inhaled the chloroform, folded her arms across her breast, and fell asleep chirping, "I'm an angel! Oh, I'm an angel!"—but Simpson was too occupied just then to search for her wings.

42. Describe Pasteur's first case of hydrophobia:

While the scientist thus wrestled with his doubt, an agonized mother from Alsace entered his laboratory. She brought to Pasteur, her little son, Joseph Meister. Walking unguarded to school along a country road, the helpless child had been pounced upon by a mad dog, who bore him to the ground and wounded him fourteen times. He would have been killed on the spot, had not a bricklayer finally succeeded in driving the animal off. That nameless bricklayer deserves a monument: he not only saved a child, but he hastened the proof of the Experimental Method!

Joseph Meister was nine years of age. What memories must have awoke in Pasteur! He too was just nine years of age, when

standing by his father's tannery he had seen a bitten person seared by the blacksmith's iron. For that ancient ordeal, so terrible and so inadequate, Pasteur now substituted a little rabic marrow in a Pravaz syringe.

As the rabic medulla increased in virulence, Pasteur shuddered at the inoculations. When the patient was injected with marrow of such strength that it produced hydrophobia in unprotected animals within a week, Pasteur could no longer sleep. We love this man for his insomnia. Ghosts haunted him throughout an appalling night that would not end: he saw the look of alarm on the child's face, he saw him in vain try to swallow, he heard the paroxysms of choking as the boy perished from the cruelest malady known to medicine. Would dawn never come again? In the morning, Pasteur was a sick man. Taking his daughter with him, he left his laboratory and fled to the country, leaving little Meister in the care of one of his disciples, J. J. Grancher. Pasteur attempted to rest in Burgundy, and then at Arbois, yet was ever tortured by the conviction that a telegram would come from Dr. Grancher announcing the death of the first patient treated by inoculation.

But with a pin-prick, the genius of Pasteur had established immunity. Not only did Meister remain in perfect health, but he imagined himself in the best of luck, for he soon made pets of Pasteur's rabbits, chickens, white mice and guinea-pigs. More than one of these animals, predestined for laboratory purposes, was saved by the pleadings of Master Joseph. After Meister's return to his native Alsace, the blue-eyed lad frequently received letters that were postmarked Paris. About a year later, when funds were being raised to establish a hydrophobic service, Pasteur, while looking over the list of subscribers, was happy to find the name of Joseph Meister.

Upon Pasteur's election, a few years before this, as One of the Forty, he had been welcomed in a remarkable address by the author of *Averroes;* not content with enumerating, in bewitching language, Pasteur's actual accomplishments, Renan had played with prophecy: "Humanity will owe to you deliverance from a horrible disease and also from a sad anomaly: I mean the distrust which we cannot help mingling with the caresses of the animal in whom we see most of Nature's smiling benevolence." Ernest Renan lived to see the truth of his augury.

43. Describe Pasteur's second case of hydrophobia:

Louis Pasteur's second case of hydrophobia was fully as interesting as the first. Six shepherd boys, from Villers-Farlay in the Jura, were tending their flock, when an enormous dog, lashing his jaws with fury, charged upon them. The children rose in fear, and it was pathetic to watch their attempt to fly with trembling limbs before a swift-moving terror that gained every moment upon them. Only the eldest of the group did not run. Whip in hand, Jean Baptiste Jupille, fourteen years of age, met the mad animal. In the struggle that followed, the whip fell to the ground. With bleeding hands, the shepherd took off one of his wooden shoes and began to beat the animal upon the head. Chance moved back and forth over the meadow that autumn morning. At length death overtook the mad creature, but his mark was likewise on Jupille, covered with rabid blood and saliva. Only from Pasteur could the young hero hope for life.

Meister had been brought to the laboratory in less than three days after his accident, but six full days elapsed before Jupille received his initial injection of the mitigated virus. Pasteur complimented the boy on his courage, and found that Jupille was embarrassed at being praised. At the Academy of Sciences, Pasteur, after explaining the technique of his treatment, could not refrain from extolling Jupille's deed of self-sacrifice. Baron Larrey, usually the most impassive of men, thereupon arose, and proposed that the Académie Française bestow upon Jupille the Montyon Prize. The young shepherd from Villers-Farlay became a French sensation.

44. Describe some of Robert Koch's discoveries:

Koch's letter to Ferdinand Cohn, a Further Contribution to our Knowledge of Febris Recurrens and of the Spirochetes, together with his work on the Transmission of Recurrens-Spirochetes to Apes, were published during 1879. The year 1880 marked the removal-period from Wollstein to Berlin, and in 1881, in the capacity of a member of the Imperial Health Board, Koch published papers on the Etiology of Anthrax, on Disinfection, on Disinfection with Hot Air (with Wolffhügel), on the Value of Superheated Steam for Purposes of Disinfection (with Gaffky

and Loeffler), and on the Accommodation Theory of Molds. This same year witnessed the publication of his paper, The Investigation of Pathogenic Microörganisms, which contains his first reference to his invention of transparent solid media, the introduction of which opened up a new world for bacteriologists. Up to that time two kinds of media had been in use, either a fluid one which was transparent, or else a solid one which was invariably opaque. Both suffered from serious deficiencies. In the fluid media the germs grew in a wild and irregular manner so that to study them under the microscope was impossible; whereas, while the solid, opaque media offered no difficulty to the fixation and isolation of the microbes, they were, by their very opacity, insusceptible of observation with the microscope. It was a fortunate inspiration that came to Koch whereby he combined a third medium from these two, the new one being both solid and transparent. This he accomplished by converting the ordinary fluid media into solid ones by the addition of a coagulable substance. As a fluid medium Koch first used simple beef broth and as a coagulable substance, gelatine, which, when added to the medium leaves the latter absolutely transparent. Later the procedure was modified in many ways, at least as far as the nutritive medium was concerned. In addition, Koch learned how to obtain a very useful, transparent, solid medium from the blood serum. The nature, as well as the applicability of the improvement, however, remained the same. The first advantage is that with the solid, transparent medium it is possible to isolate the individual bacteria and to obtain really pure cultures. In the second place there is the advantage that the cultures can be studied microscopically with the greatest exactitude as regards their biological characteristics. It is out of this transparent solid medium that Koch developed his method of plating which has since been one of the most fundamental of bacteriological procedures.

On Monday, April 10, 1882, when Number 15 of Carl Anton Ewald's *Berliner Klinische Wochenschrift* appeared, the opening contribution was the immortal paper which Koch had read seventeen days before at the Physiological Society. A complete report on the Etiology of Tuberculosis was given to the world during 1884. The years which have passed since its publication have stamped it as an imperishable classic which should form part of every medical man's education.

45. How was phagocytosis discovered?

Elie Metchnikoff and his family were spending their vacation in Messina. One day some clever apes arrived in town, and Madame Metchnikoff and all the children went to the circus. Metchnikoff has told how he remained alone with his microscope, watching the moving cells of a transparent star-fish larva. The idea flashed across his brain that the mobilization of such cells might serve in the defense of the organism against the invaders of the body. Feeling himself on the trail of a great discovery, an intense excitement possessed Elie Metchnikoff. He began by striding up and down the room, but finally rushed to the seashore to collect his thoughts. In the Sicilian garden which he rented, grew a small tangerine tree which had been arranged as a Christmas tree for the children. Taking a few rose thorns from it, he introduced them within the skin of the star-fish larvæ, and found that in spite of the larva's lack of vascular and nervous systems, its mesodermic cells accumulated around the intruding thorns, just as the white blood cells of man surround a splinter or germ that enters the body. Thus was born the theory of phagocytosis—the doctrine that when microbes or other deleterious substances attack the body, an army of phagocytes rush to the injured part, hurl themselves upon the enemy, attempting to engulf and devour the invaders. While his family was away at the circus, Metchnikoff had climbed to immortality. Upon their return, the children spoke of the wonderful tricks of the performing apes, and no one knew of the revolution which had taken place in Metchnikoff's life. His career as a zoölogist was over: he was transformed into a pathologist, and although he had no medical training, he became a leader in humanity's warfare against infectious diseases.

46. Name some early American medical discoveries:

America, in its colonial period and statehood, learned its medical alphabet in Europe. In time the student-nation began to read lessons which the older eyes did not discern. American medicine has no antiquity, but in the young story are bold deeds. By candle-light in a New Hampshire town, a surgeon saw a lad bleeding to death from a wounded artery in the neck; it was too late to seek trained assistants, and aided only by the patient's

mother, he saved the fast-ebbing life; he rode off on horseback without plaudits—he had been rejected by Harvard because he lacked preliminary education—but he was the first in history who tied the common carotid. In America the ligature was first placed around such important arteries as the innominate, subclavian and common iliac. In the backwoods of Kentucky woman was first relieved of ovarian tumor, and among the wilds of Michilimackinac the human stomach was first seen and studied in situ. An American pen wrote the first burning protest against the slaughter of mothers in childbed, and an American knife removed the vesico-vaginal fistula from the hopeless afflictions of the female sex.

47. Name the landmarks in electricity in the nineteenth century:

The Nineteenth Century opened with William Herschel's discovery, by means of the thermometer, of the invisible infra-red zone, and in the following year, 1801, Ritter and Wollaston found the ultra-violet band. Faraday's demonstration of electromagnetic induction, Joseph Henry's discovery of the oscillatory nature of the discharges from a Leyden Jar, von Middeldorpf's improvements in galvano-cauterization, Julius Althaus' work on the therapeutic possibilities of electrolysis, Duchenne's stimulation of individual muscles by moistened electrodes to the overlying skin, and his application of electrotherapy to neurology, Robert Remak's study of the direct current in joint diseases, von Ziemssen's mapping of the motor points of the surfaces of the body, Apostoli's introduction of electricity into gynecology, Bruck's idea of electric illumination for medical diagnosis, Clerk Maxwell's electromagnetic theory of light waves, Heinrich Hertz's discovery of electromagnetic action throughout space, Geissler's production of the vacuum tube, Crookes' researches on the radiant or fourth state of matter, William J. Morton's static induced current, d'Arsonval's investigations of high-frequency currents, Nikola Tesla's suggestion of diathermy, are among the forces which blazed new paths in electrotherapy.

48. Name three discoveries of importance in physiotherapy:

In its dying years, the Nineteenth Century bequeathed to its successor three discoveries, infinitely romantic and of enduring

importance. In October 1895, a teacher of physics, contemplating an exhausted vacuum tube in a black box, noticed that a paper screen covered with barium platinocyanide which accidentally lay nearby, became fluorescent. His curiosity aroused, he soon found that the unknown radiations from the tube could pass through substances opaque to ordinary light, and possessed the power of developing a photographic plate. Two months later, Wilhelm Konrad Roentgen gave to mankind, as a Christmas gift, the x-ray. At about the same time, a young Dane, the Hamlet of medicine, born among the fjords and fogs of the Faeroe Islands of the North Sea, reared in Iceland, hopelessly ill since youth, captured the sun for therapeutics. Niels Finsen was the first, consciously and scientifically, to employ artificial sunlight in the treatment of disease. The light from Finsen's lamp gave us phototherapy. While these experiments, blended with genius and pathos, went on in the north, a man and woman moved into an abandoned shed on the outskirts of Paris, and worked there for many hours during the day, boiling and stirring in a large cast-iron vessel tons of waste material—brown dust and pine-needles that had come from the forests of Bohemia. Sometimes the man wrote formulas on the blackboard, while his wife prepared the tea on the broken stove. Often they returned to the shack in the evening, for out of that basin had come strange products—luminous silhouettes, glowing like fairy lights in the dark. One night Pierre and Marie Curie looked longer than ever, for in their magic pot they found Radium.

Physiotherapy in the Twentieth Century may be equally proud of its heritage and its present status. It has added a new thrill to the somewhat discouraged art of treating the sick. It has placed in our hands undreamt of weapons for the conquest of disease, but they are new, and we must learn to use them. The relationship of radium and the x-ray to the living cell—the marriage of physics and biology in the realm of light—initiates problems which no single generation can hope to solve.

49. Discuss the significance of Freud:

At the turn of the century, a middle-aged Moravian who was teaching in Vienna, committed the boldest act of modern times. Sigmund Freud, in his interpretation of dreams (*Die Traumdeutung,* 1900), developed a new method of diagnosis and treat-

ment, which differed materially from the classic ideal of curing "quickly, safely, pleasantly." The auricular confession of the Church is child's play in comparison with the confessional established by this Jewish physician. From the subconscious depth of forgotten memories, Freud has dragged up the psychic traumata of early childhood. He exposed the origin of compulsion-neuroses, and reopened destructive wounds long buried in oblivion. Unheeding the opposition of his profession and society, he emphasized the dominance of sexuality and the neurotic diseases arising from its repression. Submerged mental processes, struggling to be born, were brought to light by the new obstetrician. To psychology he added depth-psychology, and to physical pathology the vaster realms of psychopathology.

Freud has covered so much unfamiliar ground that undoubtedly he has often gone astray; some of his chief disciples have forsaken him, and struck out into organic paths. Psychoanalysis, as originally propounded, may be largely revised in another generation. That does not detract from its value, nor from the merit of the founder. Freud has opened new territory for our investigation, and we will never again live in the narrower pre-Freudian era. Not only the medical sciences, but mythology, religion, history, biography, literature and art, have been influenced by the application of psychoanalytic methods. There is substantial truth in Freud's contention that the three cultural epochs of mankind are the Copernican revolution, Darwinism, and Freudism. Psychoanalysis, howsoever modified in the future, will continue to explore the hitherto uncharted regions of the mind, and Freud will be rememberd as the great geographer who first mapped the Subconscious World.

50. Name some medical contributions to biology:

The foregoing survey to some extent makes it apparent that the study of living matter is the offspring of medicine. The Hippocratists and the Alexandrians were the great practitioners of antiquity; Galen was physician to Marcus Aurelius; the patients of Paracelsus included Erasmus; Vesalius was medical attendant to the Spanish court; Harvey was physician to King Charles until Cromwell performed a sharp political experiment; Malpighi ended his days as physician to the Pope; Jenner was a country doctor all

his life; and even John Hunter, although he swore when disturbed at the wrong time, put aside his work to earn his "damned guinea." In learning the workings of tissue—how it moves, breathes, sees, hears, smells, feels, tastes, feeds, digests, eliminates, how it speaks and how it thinks, how it keeps itself warm by oxidation, how it is born and develops and reproduces itself, how it becomes diseased or grows old and dies—in investigating every particle and function of the living machine, these physicians worked definitely in the name of medicine.

In reaching the nineteenth century, we must shift our viewpoint. Biology and Physiology now emerge as independent sciences of such vast and ever-increasing proportions, that they begin in full measure to pay back their debt to medicine. To such an extent did this proceed, that it is now more natural to think of biological contributions to medicine than of medical contributions to biology. Johannes Müller's law of the specific energy of sense substances; Henle's work in histology; the cell-theory of Schleiden and Schwann; von Baer's investigations in embryology; Purkinje's revelations with the microscope; Claude Bernard's discovery of glycogen, the action of pancreatic juice, and of the vaso-motor system; Karl Ludwig's proof of the mechanistic theory, and his introduction of the graphic method; Wöhler's creation of an organic compound from its inorganic constituents which bridged the gulf between these two worlds; Pavloff's experimentation with psychic secretion and conditional reflexes—these are types of contributions derived from medical men, and indispensable to the progress of medicine, and yet in the strict sense they are not medical contributions; they do not come from the bedside, the hospital, the clinic; they come from formulae, test-tubes, sea-slime and plant-sap. These physicians do not practise medicine, but are enrolled under the broader banner of biology. We thus realize that many of the choicest spirits of the profession wandered out of the medical camp to the frontiers of science, returning with the richest of gifts. Helmholtz, who climbed from an assistant surgeonship in a regiment of Red Hussars to the heights of mathematical physics, spoke as a medical exile: "Medicine was once the intellectual home in which I grew up; and even the emigrant best understands and is best understood by his native land."

It is evidence, therefore, of the inexhaustible productivity of

medicine, that even if we lay no claim to laboratory discoveries, and limit ourselves to strictly clinical contributions, our theme—Medicine's Contribution to Biology and Physiology—goes on unceasingly.

The Cellular Pathology of Virchow, applying the cell-doctrine to disease, gave to biology its conception of germinal continuity—every cell from a cell—which is the foundation of the study of heredity. Lister's conquest of sepsis, enabling the surgeon to enter any portion of the body, permits us to investigate living tissues without suppuration and gangrene. Beaumont's observations of the Canadian's trapper's fistulous stomach, marked an epoch in the physiology of gastric digestion; Bigelow's report of a crowbar driven through a man's brain, and Williams' stab-wound of the heart and pericardium—with recovery in each instance—are other cases, among many, in which medicine made use of trauma to increase physiological understanding. The neurosurgical knife of Macewen and Horsley, localizing lesions in brain and cord, traced the course of the nerve fibres and elucidated the functions of the nervous system. Matas' nerve-blocking, Carrel's vascular suturing and visceral transplantations, and Crile's shock-control are surgical stimuli to physiological thinking. By fluoroscopy, rendering the x-ray shadows visible, and by bringing the electric light to cystoscopy, laparoscopy, and thoracoscopy, we watch the inner organism at work.

Pharmacological medicine—nascently a clinical empirical method—in its evolution has contributed to all departments of physiology: for example, the primary clinical benefits derived from digitalis were subsequently interpreted in their true physiological bearings; quinine, in the clinical hands of Wenckebach, revealed intricacies of the myocardial mechanism which are definitely physiological. The stethoscope of Laennec, devised to detect pathological conditions within the chest, advanced our conception of the physiology of respiration—a subject further developed, particularly in regard to the bronchial musculature, by Einthoven's clinical study of bronchial asthma and the vagus nerve; Killian's employment of bronchoscopy to demonstrate the functioning of the bronchial tree, and Gutzmann's turning stroboscope which enables us to see the fine vibrations of the individual vocal cords, indicate how a technical specialty can contribute to physiology. From Mackenzie's purely clinical labors has grown the newer

knowledge of cardiac physiology; and clinicians, using the electrocardiagraph, have learned the secrets of the dying heart. Pediatrician and geriatrician, seeing—in Gull's telling phrases—the resemblance between the diseases of the two periods of life, like the tints of the rising and setting sun, comparing infantile diarrhea and senile diarrhea, infantile eczema and senile eczema, uric acid deposits in childhood and uric acid deposits in age, could discuss the relations of the tissues to time. Medicine, performing its modern miracles with the internal secretions—gonadal transplantation reverses sex, and thyroid-feeding turns cretins into university-students—has fulfilled the vague dreams of earlier ages. Hyperthyroidism and myxedema have explained thyroid function; Addison's disease uncovered the adrenals; acromegaly interprets the pituitary; through the study of diabetes, we have followed the whole problem of the intermediary metabolism of carbohydrates, proteins and fats.

Medicine and Biology in their quest for truth, are halted by a speck of protoplasm—within whose nucleated cell is locked the mystery of animated matter. With ever new, yet ever insufficient knowledge, we continue the never-to-be ended Journey.

SPECIMEN ESSAY

Duchenne of Boulogne [1806-1875]

A scientific journal fails in its duty of gratitude if it does not address a sympathetic farewell to those of its collaborators whom death carried away from mutual labor.

When a writer has taken his place in the first rank of workers of his generation, and when imposing discoveries are attached to his name, it is no longer a sign of affection, it is an act of justice to render to the memory of such a savant the homage which is due him.

Duchenne of Boulogne was one of ours; the greater part of his memoirs were published in the Archives, and his books have often contained but the development of those ideas of which he here had deposited the seed; it is the least that we can do if we recall within our Archives his claims to celebrity already conceded, and which posterity will confirm.

C. Lasegue and J. Straus: *Archives générales de médecine,* 1875.

Sun-tide and moon-tide make the spring-tide of Boulogne, the green-blue basin of Boulogne. Ships, herring-filled and mackerel-laden, riding to the rhythm of the harbor of Boulogne. There is no color like the color of moving water, there is no music like the music of flowing water. Boat-builders and fishermen of Boulogne, with the salt-spray on their lips and the sea's mystery in their veins—there are no men like the men who live on water. Sea-grass floating by beneath the star-silence, drifting through the channels of Boulogne, how many generations of Duchennes have you known?

Jean Duchenne and his wife Denise had four sons in Boulogne; for two hundred years the Duchennes had followed the tides, and once again the father called his children to the sea. The second son—he who was named Guillaume-Benjamin-Amant—looked the sailor, and that thickset figure seemed at home among the rigging; the fishing-smacks came in and out of Boulogne, but destiny had set Guillaume-Benjamin-Amant Duchenne upon a voyage across unmapped seas and never-reached ports.

The medical school of Paris, with a faculty then famous, now historic. . . . Duchenne, an unobtrusive and undistinguished student, graduating quietly in 1831 with a forgotten thesis on burns. . . . Bichat was the favorite of Desault; Bretonneau was as a father to Trousseau; Laennec found a medical brother in Bayle; Louis was much attached to young Jackson; Magendie helped Claude Bernard, who in his turn rendered service to Paul Bert.

But Duchenne made no impression upon his teachers. An assistantship was not offered, no one requested him to remain, and it is doubtful if he could have obtained an appointment for spreading mercurial salve at the Hôpital du Midi—the great venereal realm of Ricord, known as the worst-conducted and dirtiest hospital in Paris.

Duchenne returned to Boulogne-sur-Mer, married Barbe Boutroy, and became a father. The years passed, his wife died, and he continued to practise medicine among the fisherfolk. His sea-dreams have been lost, for only poets tell these things: one who knew Boulogne in his youth, and ever bore within him the disease of life, wrote these words of water:

> O water whispering
> Still through the dark into mine ears—
> As with mine eyes, is it not now with hers?—
> Mine eyes that add to thy cold spring,
> Wan water, wandering water weltering,
> This hidden tide of tears.

In 1842, after eleven years in Boulogne, Duchenne came back to Paris. The minister of instruction did not send for him and no director of clinics welcomed the unknown doctor, who had certain ideas he wanted to work out. Some time previously, Magendie and Sarlandière had experimented with electropuncture—and the chief result of these experiments was their effect on Duchenne. It appears that Magendie was neither a gentleman nor a scholar, but it is remarkable how frequently he vitalized, actually galvanized, the work of others. We could like this man for his frankness, his unassuming simplicity, his energy and keen intelligence, but his inhumanity to animals makes us draw back. Magendie's foramen still remains above the calamus scriptorius, Magendie's law will ever stand in physiology, and were we not confused by the cries of dogs tortured in experiments that were often aimless and useless, we could quote with better grace the words of Brunton: "Magendie not only laid the foundation-stone of modern pharmacology, but left behind him works which may still serve as a model for investigators." We do not know which is worse—the anti-vivisectionist who holds all experimenters in abhorrence, or the experimenter who looks with scorn on all who feel compassion for animals. Nature, the blundering giant, has made it im-

possible for man to secure certain knowledge except by inflicting pain upon the lower creatures.

Every day Duchenne visited hospitals, ransacking case-reports, questioning and arguing with the physicians, following patients from institution to institution. Now, Paris may be unconventional on her boulevards, but her hospital etiquette is rigid. Duchenne was not a member of any staff—what was he doing on exclusive territory? At first the attendants laughed at him and his provincial accent, later they regarded him as a nuisance and a crank. He seemed to have infinite leisure, and wanted to know what no one else knew or cared about. This sea-captain's son with the broad shoulders should be on a sloop, instead of disturbing the clinics. Evidently he had no practice of his own, else how could he have found the time to spend so many days upon a single case, even tracking the patients from house to house? His coming came to be dreaded, and he received rough treatment. Not only internes and chiefs, but "sensitive students" objected to his unofficial presence. As well insult a brass statue! Duchenne's bronzed and bearded face did not disappear from the clinics. In pursuit of his studies, he was clothed in armor which no rebuff could penetrate. Every day Duchenne came to the hospitals as a volunteer worker, gathering material which the others discarded.

"Persist," said the last of the Victorians, "if thou wouldst truly reach thine ends." Too much in earnest to be courteous, without diplomacy, handicapped by an awkward manner and a Boulognese tongue, Duchenne persisted. He achieved many enemies, but as he could not be rebuked he arrived at the stage where he was tolerated at the hospitals, and then welcomed. His naïve interest in the cases, his extraordinary knowledge of diagnosis and treatment, and his profound conviction that no one understood neurology except himself, made him physician-at-large to the Paris hospitals. There came a time when there was no more familiar sound in the wards than the characteristically explosive *Bon!* of Duchenne—when he had solved a problem.

Duchenne's hard work resulted in recognition. Patients demanded his services; successful practitioners called him in consultation; learned societies elected him to membership; his books passed through several editions, and were translated; he had contact with Charcot and Ludwig; de la Rive came to his laboratory; Becquerel recognized his existence by disputing with him about

magneto-faradic instruments; Jamin watched his electrophysiological experiments; Le Roux spoke of the value of his apparatus; Aran said, "I owe a thousand thanks to Duchenne"; Trousseau, standing at the head of the French profession, popularized his ideas by tongue and pen; the authors of *Gunshot Wounds and Other Injuries of the Nerves*—S. Weir Mitchell, George R. Morehouse, and W. W. Keen— wrote: "The only important means in the treatment of paralysis arising from default of innervation, is faradization by the method of M. Duchenne"; while Charcot asked a significant question: "How is it that, one fine morning, Duchenne discovered a disease which probably existed in the time of Hippocrates?"

No man in Paris knew the hospitals better than Duchenne, yet he never received a hospital appointment nor filled an academic chair. His method did not permit him to be fettered by official positions, and no single school or hospital would have sufficed for his researches—he found it necessary to roam through the hospitals at will, and even to visit those of other countries. Considering Duchenne's temperament, this method was essential, but of course Gilbert Breschet could not have functioned that way. The disadvantage was that Duchenne did not have control of the autopsies, but when accused of neglecting pathological anatomy, he defended himself nobly:

> Those who have made these reproaches were doubtless ignorant of the fact that I have merely been permitted to glean, as it were, in our hospitals, and that if I have been able to exist in a scientific sense, it is only because I have been fortunate enough to collect, by searching over the numerous clinics of our hospitals, certain clinical facts which have been, I will not say despised, but, rather, which have escaped notice. Those who have criticised me should know also that when I have happened to discover a morbid species not hitherto described, I have had no control over the subjects upon which, when living, my clinical observations were made. I should have had, it is true, the right of completing my researches by anatomical investigation if I had been a hospital physician. But then, riveted as it were to my own wards, I should not have been able to do the work of a searcher which I set myself to do, and I am sure that my chief works (among others those on progressive muscular atrophy, atrophic paralysis of childhood, progressive locomotor ataxy, glosso-labio laryngeal paralysis, and pseudo-hypertrophic paralysis) would never have seen the light. To accomplish these, in short, a field of observation more vast, and extending to all the hospitals of Paris, was necessary. If then I have renounced, and still renounce, the honour of an official position, it is because I wish to give myself up freely and entirely

to my irresistible taste for physiological and pathological researches. Ought it to be a subject of reproach to me that I have disinterestedly followed science solely for the love of it?

Having benefited some deaf persons by faradization, he was besieged by the deaf and dumb—frantic for relief, and ready to believe in miracles. "Willingly or otherwise," said Duchenne, "I was compelled to continue my experiments, although they were but little in harmony with my tastes." Duchenne's experience with the congenital deaf-mute Raymond is one of the most interesting cases in the annals of otology: Raymond was congenitally deaf; he did not have convulsions, but he could hear neither the loudest cries, nor the ringing of a powerful alarm near his pillow, nor the diapason when placed on the cranial wall. He perceived only explosive sounds, and the prognosis of Menière was bad. Duchenne himself believed in the incurableness of deaf-mutism, and disliked experimenting under such circumstances; it was only to please the child's parents that he undertook the case.

Without hope he applied his instruments, but the results surpassed all expectations. At the fourth sitting, the child manifested that he perceived sounds—and he began to repeat what he heard. "Nothing," says Duchenne, "can describe the emotions of the mother as she thus made her child for the first time hear the human voice, to which she had been taught to believe that he was incurably deaf. And with what mingled joy and ardor she proceeded to give her first lesson to the newly born speech and hearing." In a short time the hitherto voiceless Raymond heard well and was able to pronounce *papa, maman, bonbon.* After the suspension of the treatment, the physician did not see his little patient for a considerable time, but when they met again, the boy—who was very intelligent—said clearly, "Bonjour, monsieur le docteur Duchenne de Boulogne."

Duchenne's medical life was crowded with interesting cases. He became the talk of the town when he drew from his bed a patient regarded as absolutely paraplegic, and loaded him with the weight of a full-grown man, which the supposed paralytic bore without flinching. In a former century, this would have warranted an accusation of witchcraft. Duchenne reported the following case in his *Localized Electrization*:

A pastrycook's boy, fifteen years old, of eccentric character, had endeavored to drown some imaginary troubles in drink; and had the notion, in his

intoxication, to try to asphyxiate himself by creeping, during the night, into a sort of hole situated over his master's oven, where he remained to sleep himself sober. The next morning, the men who went to light the fire saw one of his feet, and drew him, seemingly lifeless, from the place where he had passed the night. Living in the same house, I was able to try, a few minutes later, to recall him to life by faradization. His face was blue, there was no respiration, a mirror held before his lips remained untarnished, no pulse could be felt, the action of the heart was not discoverable by the hand, but on auscultation, feeble valvular sounds were heard. While I made this examination my induction apparatus had been got ready by my son, who assisted me. I was about to excite artificial respiration through the phrenic nerves, when I saw that the rheophores had been forgotten. The danger being very urgent, I instantly applied the metallic extremity of one of the conductors of the induced current of my instrument (at its maximum, and with rapid intermissions) over the left nipple, and moved the other conductor about over the apex of the heart. After a few seconds, slow and weak respiratory movements appeared, and increased progressively in frequency and depth; and, at the end of a minute, the pulse could be felt. Soon afterwards, the face assumed a slight expression of pain. In a few minutes the patient uttered a faint groan, and moved first the arms and then the trunk, as if to remove the conductors from his chest. Then he gave a loud cry, kicking with his feet at the people surrounding him, and began to reply to the questions that were asked. In five or six minutes the respiration and circulation were re-established, the color of the face was natural, and the intelligence had returned.

He appeared to be saved. However, I ordered sinapisms to be applied to the limbs and the precordial region, and warned his master that he might fall back into a state of coma, from the toxic influence of the carbonic oxide. In fact, a few minutes after the suspension of the cutaneous faradization, he no longer replied to questions; his respiration slackened, at times he seemed as if he forgot to breathe; his face became discolored and his lips blanched; then the breathing became stertorous; he could not feel when pinched; in a word, he was asphyxiated afresh. He was quickly restored by cutaneous faradization of the precordial region, applied this time less severely, as it was quickly and acutely felt. It was continued by my son for about twelve minutes, until the respiration, circulation, and intellectual faculties, were all completely restored, and he could stand erect and walk.

Believing this cure to be only apparent, I ordered his removal to the Hôtel Dieu, to the wards of Professor Trousseau, where I shortly followed him. Foreseeing that the carbonic oxide would continue its poisonous action, and produce a return of coma, I had placed sinapisms upon his legs, and had directed the person who conducted him not to let him sleep. An hour later I found him in the hospital, in a state of coma, into which he had fallen on the way, in spite of the efforts of his guide, who had in vain slapped him to try to keep him awake. It was necessary to return to the electro-cutaneous excitation of the precordial region, and to repeat it several times during the day, as well as to apply sinapisms over the body, before we were

entirely freed, towards the evening, from the tendency to consecutive coma, due to the poisonous influence of the carbonic oxide.

The life of the pastrycook's boy was saved, but the memory of this case is melancholy, because of the reference to Duchenne's son. There was a beautiful relationship between Duchenne and his son, Emile-Guillaume-Maxime, known as Duchenne fils de Boulogne. The date of his birth has not been recorded, but in 1864 he graduated in medicine at Montpellier, with a thesis—*De la paralysie atrophique graisseuse de l'enfance*—plainly showing his father's influence. The two Duchennes were much devoted to each other, and became associated in practice—until dementia præcox transferred the gifted boy from the clinics to the insane asylum. Duchenne, master of neurology, was compelled to stand by, helplessly and hopelessly, as many physicians have done before and since, and watch his only son perish in unknown darkness. In this connection, Americans think of the tragedy which obscured the soul of Bayard Holmes, most of whose writings deal with this terror of adolescence which robbed him of a brilliant and beloved son. The psychoanalytic explanation—that in dementia præcox the libido is turned back upon the ego, and this reflected turning back is the source of the megalomania—helps us not at all. Not in our generation will we see the curse of dementia præcox removed from the human race.

Duchenne wrote much, and at times used his pen as if it were a galvano-cautery: in extenuation, it should be remembered that those were the days when the most illustrious French surgeons, Dupuytren, Lisfranc, Velpeau, called one another bastards and bandits. Duchenne was not personal; he was simply so interested in his subject that he spoke of the myths imagined by Sir Charles Bell, he asserted Ludwig Türck could not diagnose locomotor ataxia, and he applied a continuous current of sarcasm to Remak.

"M. Duchenne," said Remak, "appears to be ignorant of the difference which exists between a constant and inconstant chain; although he lives in Paris, near M. Becquerel, the celebrated inventor of constant chains." Elsewhere Remak wrote: "Whoever has seen the skill and confidence with which Duchenne throws the great muscles into contraction could almost complain of his intention to preserve his secret." And Duchenne answered, bitingly: "During several hours that the séance lasted"—at which Professors Richter of Dresden, Jaksch of Prague, Hebra of

Vienna, and other German scientists were present—"Remak saw me produce, in succession, contraction of a large number of muscles *en masse,* and of separate fasciculi, the former by exciting their nervous trunks, the latter by placing the rheophores upon them, beyond the points of immersion of the nerves. This great critic, however, who has witnessed the results that I obtained, and has made them the subject of eulogy, obtained no glimpse of the particular methods that allowed me to obtain them! With whom is the blame? Did I trust too much to his anatomical knowledge? Had microscopic anatomy caused him to forget that which can be seen with the naked eye? Such seems to be the only solution of the enigma." In this manner, many of the pages of Duchenne and Remak—two workers whose discoveries are of permanent value to science—are marred because each insisted that the other was an ignoramus. Despite this long drawn-out Franco-German battle, Duchenne's disease, Duchenne's syndrome, and Duchenne's paralysis survive in our nomenclature, along with Remak's fibres, Remak's ganglia, and Remak's plexus. It is said that Duchenne was too original to be much of a reader, and had he been more familiar with Romberg and Erb, he would have avoided unnecessary controversy. Nevertheless, in his work we find frequent references to other investigators, usually with historical retrospects and bibliography. He is full of praise for Claude Bernard and after confessing, "Claude Bernard has shown that section of the chorda tympani dries up the secretion of the submaxillary gland, while my experiments, although repeated a hundred times, had not made me even suspect the existence of this fact," he pays a characteristic tribute to his great contemporary. The following gives us an insight into Duchenne's method:

> Contrary to ordinary custom I have not prefaced my work on locomotor ataxy with any historical considerations, and I owe some explanation of it to my readers. When one wishes to devote oneself to the observation of the signs of disease and their nature independently of all external influence it is necessary, I think, to guard against filling one's mind with the work of others who have dealt with the matter in hand. This is a principle from which I have never deviated, always postponing till the end my bibliographical researches, and never mentioning the work of others until I have given my own. Had I done otherwise I should always, as it were, have been looking at my facts with another man's spectacles, and this must have hindered my own observations.

Once again we cite Claude Bernard—his remark to his friend

Gambetta: "It is that which we do know which is the great hindrance to our learning that which we do not know." The books of learned men have often been stumbling blocks in the path of medical progress. Stahl was a scholar, and because of his erudition he was able to do more harm to science than a hundred untutored quacks: by his fiction of phlogiston, he confused chemistry for a century; as the father of vitalism, and the protagonist of the doctrine that organic phenomena are not governed by chemico-physical laws, but by the laws of the "sensitive soul," he trammeled biology with a farrago of mysticism from which it is not yet wholly free; and by his claim that all varieties of insanity resulted from impious perversions of morality, he was responsible for much brutality in psychiatry. Knowledge, in the possession of a mind that cannot interpret it without prejudice, is a dangerous weapon. Ludwig Choulant, recently revived by Mortimer Frank, was one of the most learned physicians of the nineteenth century: he produced an amazing list of translations, bibliographies, chronologies, medico-historical essays, editions of classics, monographs and text-books. As a practising physician, professor and director of the Dresden Medico-chirurugical Academy, he had the opportunity to remain well-balanced and forward-looking. Yet even his fine aphorism—"The history of a science is the palladium of its freedom; it prevents it from being tyrannized over by narrow, bigoted viewpoints"—did not save him from the dogmatism of a Jacobus Sylvius or a Georg Ernst Stahl. The last of the great symptomatologists, Choulant was expert in questioning patients about their symptoms and in observing the external manifestations of disease, but he opposed vehemently the advances in physical diagnosis, chemical and microscopical findings, and pathologico-anatomical methods. Thus the savant Choulant, in the midst of innumerable folios, stands as an obstructionist in science, while Duchenne, rheostat in hand, emerges as a pathfinder.

It takes a long time before an idea in medicine filters throughout the profession: there are important suggestions in Hippocrates still awaiting application. Duchenne and others knew of the causal relationship of lues to locomotor ataxia, but long after his death, the profession still blundered. The fifth and concluding volume of William Pepper's System of Medicine was devoted wholly to nervous diseases, the most frequent malady of

the spinal cord being from the pen of E. C. Spitzka, one of the acutest and best-informed American neurologists of the day. In the first place, Spitzka showed himself adrift from the facts by regarding tabes dorsalis and locomotor ataxia as separate entities; he floundered in deep water by scornfully rejecting Erb's statement, that "tabes dorsalis is probably a syphilitic disease whose outbreak is determined by certain accessory provocations"; and under etiology he showed himself entirely at sea, by listing as among the causes of tabes: the crime of Onan, coitus in the upright position, worry and psychic jars, poisoning by illuminating gas, the taking of absinthe, the eating of ergot, the shock of the Ashtabula disaster, falling from a chair while trying to keep a row of books from coming down, and—most important and most indisputable of all—wet feet. Alas, for American neurology in 1886! We have dilated on the evils of too much reading, but in this instance it would have been better for our profession, and for their patients, if Spitzka and his colleagues had read and believed the works of Duchenne.

In Duchenne's *De l'Electrisation Localisée,* published in 1855, he laid down the essentials and fundamentals of electro-therapy: more than ten years later, A. D. Rockwell graduated in medicine, and in looking back to that period, stated: "During all my medical training I do not recall that electricity was ever mentioned in connection with therapeutics or even surgery." He was introduced to curative electricity by an old irregular—Doctor (by courtesy) William Miller—whose electrical and intellectual equipment were equally meager, but who possessed the rarer virtues of honest enthusiasm and a good heart. When Rockwell first broached the subject to the leaders of the profession, Austin Flint said, "I cannot lend my name to any such project"; Willard Parker said, "It isn't worth your while—any old woman can apply electricity"; E. R. Squibb, the noted drug manufacturer, did not exactly say anything, but he asked, "Are these men regular?"—and it was the doughty Squibb who prevented young Rockwell from reading a paper on the subject before the Kings County Medical Society. Stories of the early days of electrotherapy in America, with reminiscences of the dynamic G. M. Beard, "father of neurasthenia," will be found in Rockwell's *Rambling Recollections.*

Even the friends of Duchenne admitted his prolixity, but in this connection two factors must be remembered: in the first place, there was more time in those days; and secondly, it was customary for the French physicians of that period to describe their cases in great detail. Velpeau, the blacksmith's son, rose to surgical eminence against the obstacles imposed by utter poverty and bitter enmity, yet by the time he reached his mid-forties he had sent to press over twenty-five thousand pages. Compared with this ceaseless output, Duchenne's bibliography of some fifty titles seems moderate, even if he did not always avoid circumlocution.

The man's honesty is obvious on every page, whether he is quarreling with the German neurologists, or reverently correcting a line upon the forehead of Laocoon, or carrying forward Borelli's work on the diaphragm and Charles Bell's work on the hand, or grandly philosophizing, "If it were possible to master the electrical current, especially in the face, we could, like nature herself, paint upon the human visage the expressive traces of the emotions of the soul."

Out of the numerous writings of Duchenne, three works stand forth as masterpieces in medicine—*On Localized Electrization* (1855), *The Mechanism of the Human Countenance* (1862), and *The Physiology of Movements* (1867). The first, by applying electricity to pathology, created the science of electrotherapy; the second, by its electrophysiological analysis of physiognomy, explained the human face; and the third, with its electromuscular observations and experiments, is the organon of myology. The English reader will gain a good conception of Duchenne from the brochure on nervous deafness, translated by Laurence Turnbull (1863); from the first portion of the treatise on localized electrization in the translation of Herbert Tibbitts (1871); and from the volume of clinical selections, ably edited for the New Sydenham Society by George Vivian Poore (1883).

If the writings of Duchenne of Boulogne, like those of Philagrius of Thessalonica were lost, his name would survive, not only in its various eponyms, but because he has been embalmed for immortality by the central figure of modern science. In his *Expression of the Emotions in Man and Animals* (1872), Charles Darwin frequently quotes Duchenne—"and I could not quote a

better authority"—uses many of his facts and photographs, and renders him this unforgettable tribute:

> In 1862 Dr. Duchenne published two editions, in folio and octavo, of his "Mécanisme de la Physionomie Humaine," in which he analyses by means of electricity, and illustrates by magnificent photographs, the movements of the facial muscles. He has generously permitted me to copy as many of his photographs as I desired. His works have been spoken lightly of, or quite passed over, by some of his countrymen. It is possible that Dr. Duchenne may have exaggerated the importance of the contraction of single muscles in giving expression; for, owing to the intimate manner in which the muscles are connected, as may be seen in Henle's anatomical drawings—the best I believe ever published—it is difficult to believe in their separate action. Nevertheless, it is manifest that Dr. Duchenne clearly apprehended this and other sources of error, and as it is known that he was eminently successful in elucidating the physiology of the muscles of the hand by the aid of electricity, it is probable that he is generally in the right about the muscles of the face. In my opinion, Dr. Duchenne has greatly advanced the subject by his treatment of it. No one has more carefully studied the contraction of each separate muscle, and the consequent furrows produced on the skin. He has also, and this is a very important service, shown which muscles are least under the separate control of the will.

In evaluating Duchenne's services, the first award must be made for his refusal to accept any statement until he had tested it. Time and time again, the foremost scientists have led us astray in the very fields where we expected their light to shine brightest. Karl Ernst von Baer, the discoverer of the human ovum, author of the germ-layer theory, and creator of comparative embryology, is honored as the father of modern embryology, yet extraordinary as it seems—after it had been proved by others—this master of his subject stubbornly maintained that the spermatozoon has no connection with fertilization. It remained for lesser embryologists to detect and demonstrate the germ-cell uniting with von Baer's egg. It reminds us of Aristotle whose brain gave birth to the biologic sciences, and yet denied that the brain is the source of intelligence.

It was an important day for medicine when Duchenne placed two wet electrodes on the moistened epidermis, and found that the current ignored the skin but localized its action on the muscles and subjacent nerves. With this key he opened a new door to neurology. Instead of the painful and dangerous method of electropuncture, he taught the physician how to limit and control

electrical excitation without pricking, incising and damaging the patient's skin.

He described and named one of the best-known of the idiopathic atrophies—pseudohypertrophic paralysis of Duchenne. Of this awful and incurable disease of childhood we know no etiological factors except heredity: the mother, though herself unaffected, passes the affliction to her sons. With strange incongruity, the muscles enlarge while weakness increases; then wasting ensues, and the boy is unable to stand; the knee-jerks are abolished, and only the moving hands are left to protest against an inexplicable fate. There is no treatment, and slowly and surely, complete paralysis ends the miserable picture. How anyone can look through a Textbook of Pediatrics, and contemplate the cruel and senseless tortures especially reserved for childhood—and then believe all that we are asked to believe about the Universal Beneficence, is something we fail to fathom.

Duchenne's name is associated with a more widespread disease of children—acute anterior poliomyelitis. One of its synonyms is acute fatty atrophic paralysis of Duchenne; his son also published investigations of this disease. Duchenne was among the first to point out that in infantile paralysis the locomotor system was wrecked by definite lesions in the anterior horns of the spinal cord. He discovered the relation which the faradic current bears to the affected muscles, devised many artificial muscles to supplement the paralyzed natural ones, and laid down the prognostic law, "All the cases of infantile paralysis which I have seen where the faradic contractility was diminished but not lost, and which could be treated by faradic electricity within two years after the onset of the paralysis, have completely recovered."

Either our hands are less skillful or less faithful than those of Duchenne, for we cannot accomplish with the electric current all that he claimed to do. Electricity has won her greatest victories, not in medicine, but in industry. Moreover, infantile spinal paralysis is more virulent now than in Duchenne's time. As late as 1906, Emmett Holt published the statement that poliomyelitis is unaccompanied by danger to life: the next year, in the summer and the sunshine, the invisible enemy approached and left behind it not only atrophied legs and twisted backs, but plenty of young corpses. About ten years later it broke forth with such unexampled fury as to become a great American menace

—it was the Children's Plague, and there is nothing more pitiful than the impotence of Medicine when an unchecked epidemic invades the nursery. The encouraging voice of Duchenne was not heard in 1916.

The wasting palsy of adult males—progressive spinal muscular atrophy—was first accurately described in Duchenne's *Atrophie Musculaire avec Transformation Graisseuse* (1849), followed by the researches of Aran (1850), and is known as Duchenne-Aran's Disease. This horrible malady of unknown origin begins in the hands, and when the muscles of the ball of the thumb become useless, followed by atrophy of the interossei and lumbricales, we see the characteristic bird-claw hand known as the *main en griffe* of Duchenne. As Duchenne, in connection with infantile spinal paralysis described a subacute form in adults—*paralysie générale spinal antérieure subaiguë* of Duchenne—he found in connection with this adult palsy an early variety commencing in the facial muscles and known as Duchenne's hereditary infantile atrophy.

If a man begins to find it difficult to pronounce those letters of the alphabet requiring the use of the tongue for their formation, he carries his doom within him. There is no magic in the materia medica that can frighten bulbar palsy. It is never in haste, its advance is indeed slow, but only death can save its victim from its inexorable arrival. One by one the dreaded symptoms develop until he is unable to talk, or close his mouth, or swallow his food, or expectorate his saliva, or prevent its constant drooling—and all the time the mind remains clear so the patient can watch the disgusting part he plays in his own tragedy. The first complete clinical description of glossolabiolaryngeal paralysis was given by Duchenne in 1860, and it is known as Duchenne's disease. As physicians, it is our duty to treat those diseases for which there is no treatment; as neurologists, we must grow accustomed to these sights; but as human beings, we must admit there is something wrong in our protoplasm.

One of the major diseases of the world is locomotor ataxia—the aftermath of syphilis, ambushed for years in the neurones, until the posterior columns of the spinal cord collapse. Thus another of the endless victims of the spirocheta pallida joins the army of incoordination, complaining he cannot button his collar

or walk in the dark; the physician notes Romberg's sign and the Argyll-Robertson pupil; then drugs and massage and electricity occupy practitioner and patient; advice about avoidance of excitement, and injections of morphine for the tabetic crises; attempting to relieve the symptoms as they occur, and the curtain falls on an unbrained, blinded, bed-ridden paralytic, lower than any beast.

Many have described various aspects of this disease, among the chief contributions of the mid-nineteenth century being those of Martin Steinthal, Moritz Heinrich Romberg, Ludwig Türck, John Russell Reynolds, William Withey Gull—and let us ever remember Edward Stanley and Robert Bentley Todd. They advanced our knowledge of tabes dorsalis, and passed away in full medical harness: the genial Stanley while watching an operation at St. Bartholomew's was attacked by cerebral hemorrhage, within an hour succumbing in the hospital of which he was a part; and Todd saw his last patient and died in his consulting-room—it is a death that will not be forgotten, for the pen of Thackeray has etched it in his *Roundabout Papers.* Gowers, who did much to systematize the accumulating facts of neurology, contends that if the name of any man is attached to locomotor ataxia, it should be the name of Todd. But though we speak of Todd's cirrhosis, tabes dorsalis is always Duchenne's Disease. His monograph (1858) surpassed all others in clinical understanding and completeness, he differentiated it from the paralyses, he caused it to be accepted as a definite disease, he described its syphilitic parentage, and he named it locomotor ataxia after its most impressive symptom. Much work has been done in locomotor ataxia since Duchenne's time, yet immortality in this field is awaiting some physician yet unborn. Metchnikoff's simple discovery, so easily applied, would prevent this living museum of horrors, and let us hope that Wagner-Jauregg's therapeutic application of malaria to the parasyphilitic diseases will prove a new chapter in psychiatry. If Nature had only made more diseases incompatible with each other, what hopeless misery she would have saved her children!

Many who have occupied the fauteuils of the Forty Immortals are nameless dust to-day, and Duchenne, who received no official honors, lives in his works—the historical student will never be able to see a spinal cord without thinking of Duchenne. We wish we could relate that the monument erected to him in the hospital of the Salpêtrière, had been unveiled during his lifetime instead

of twenty-two years later, but such is the way of the world. Duchenne was ill the last few years of his life, and when he died from cerebral hemorrhage, he received a beggar's funeral. Over fifty years have gone since his body was laid at rest in the cemetery of Boulogne, and no biography has been written of this pioneer neuropathologist and founder of electrotherapy. The brief sketches that have appeared in French and English are altogether inadequate.

Is there no pen to tell the story of the sea-captain's son who sailed deeper waters than mariner ever knew; who touched harborless shores where lay strewn the wreckage of humanity; who penetrated unknown lands to raise a lighthouse for the tempest-tossed sailors of life? The history of medicine is replete with great names, but we cannot afford to forget the genius and the devotion of Duchenne of Boulogne.

SPECIMEN ILLUSTRATIONS

of Primitive and Egyptian Medicine

On a Reindeer Bone

Primitive carving on fragment of reindeer bone, depicting a woman in last stages of pregnancy, complicated by uterine inertia. In accordance with a superstition of the time, a large deer is seen stepping over her distended abdomen, to hasten delivery.

The limestone statuette of a paleolithic woman, dating back about 22,000 B.C., found in the loess of the Aurignacian period, and known as the Venus of Willendorf, should be compared with the living Hottentot Venus of today, since both illustrate the primitive man's penchant for fleshiness in his females. Primitive man himself is depicted as straight and slender, but he liked his women round, and thus the pendulous breasts and overdevelopment of the buttocks were due not only to too much cave-life and too much meat, but to selection. What is the endocrinologic significance of this statuette?

THE VENUS OF WILLENDORF

The Venus of Laussel

Found in a rock-shelter in the Dorgogne, showing a primitive woman holding a bison-horn. Note the invariable steatopygia. A model is now in the American Museum of Natural History, New York.

Prehistoric Skull Showing Healed Trepanation Wounds
From Meyer-Steineg and Sudhoff's Geschichte der Medizin im Ueberblick, 1922

Skull Showing Early and Recent Trepanation
From Lucas-Championnière's Trepanation Neolithique, 1912

Prehistoric Amulets

Stone Age

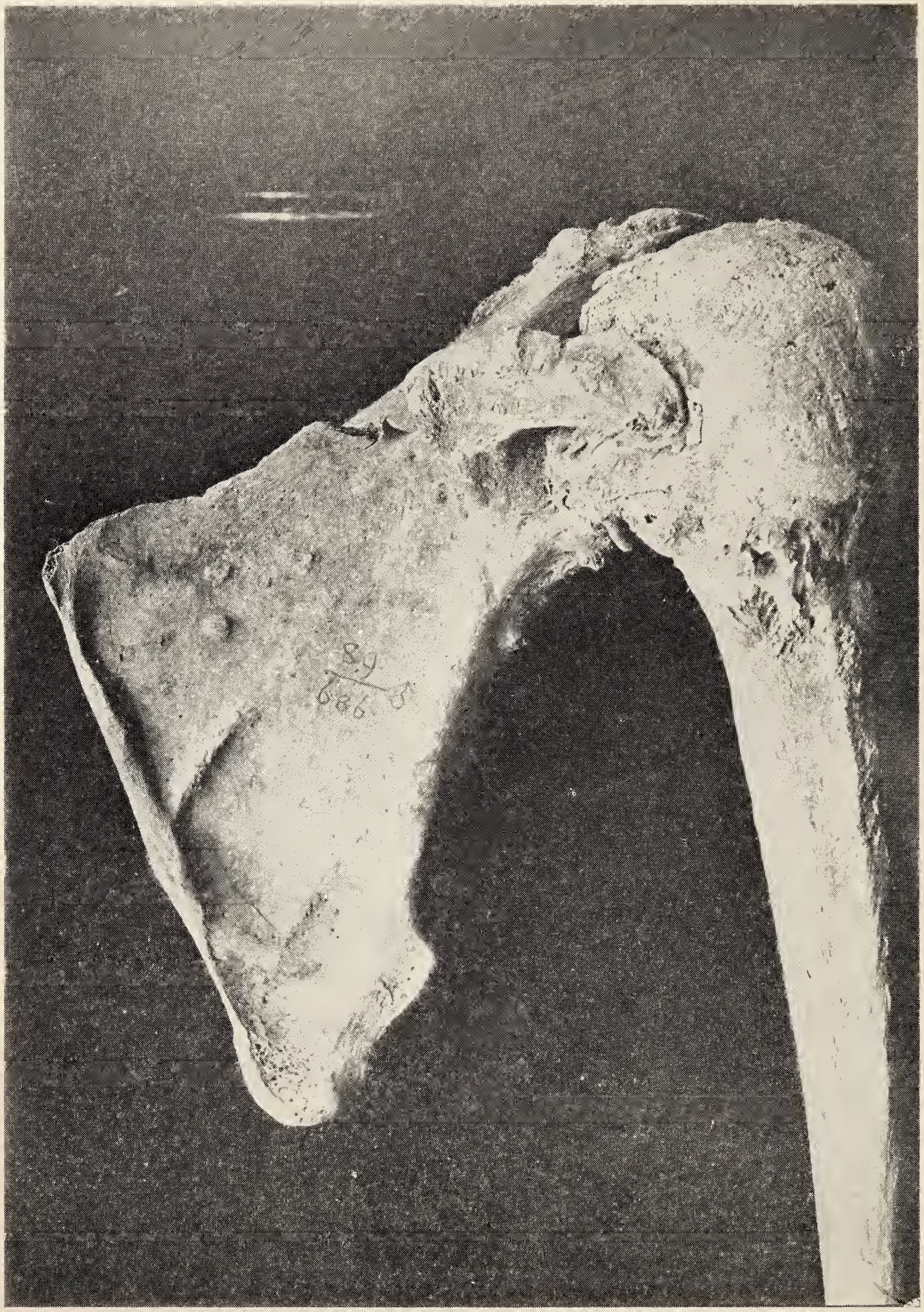
Vertebrae in which have been imbedded arrow-heads of flint

Metal Age

Vertebra containing metal arrow-head

Fig. 1, 4 and 5 Blood-letting Instruments of the Mapuche (1) and Changos (4, 5). Fig. 2, 3, 6-10 Scarification Instruments of the Changos. Fig. 11 Needles (cactus needles). Fig. 12, Clay Image from Coquimbo, showing tear stains. Fig. 13 A Stone Tobacco Pipe from Ranco lake.

From Karl Sudhoff's Archiv für Geschichte der Medizin, September 1912



Osteosarcoma of Humerus

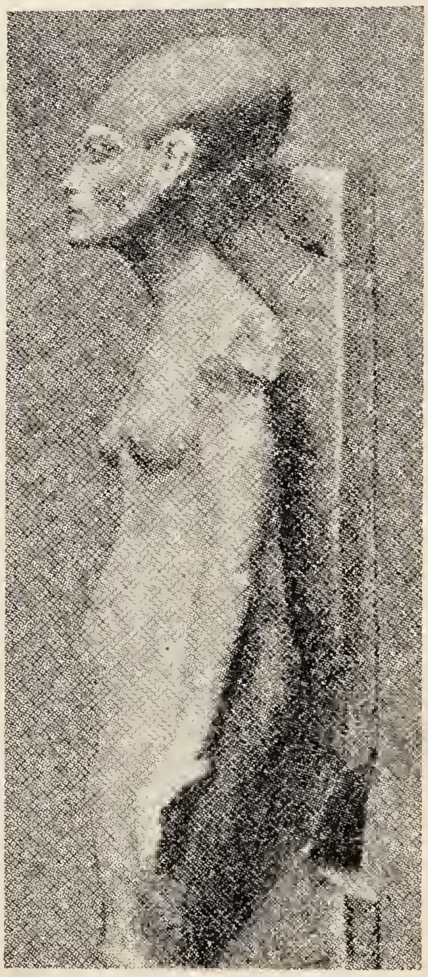
Nubia *Circa* 3,000 *B.C.*

Rectal Carcinoma Erosions (?) of Os Sacrum
Nubia *Circa* 2,000 *B.C.*

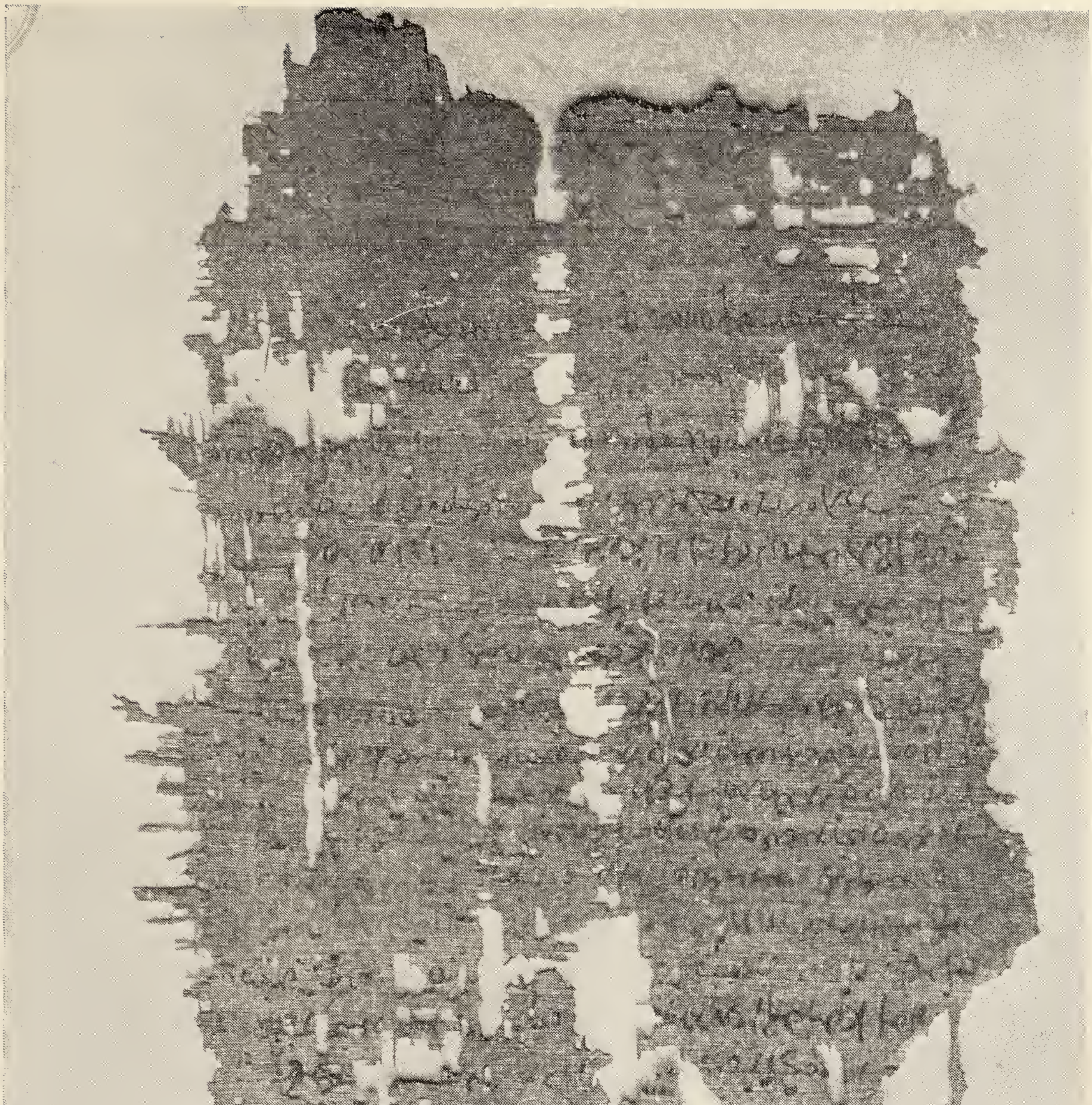
Akhnaton and Nefertiti Worshipping the Sun-Disk

Origin of Heliotherapy, Fourteenth Century B.C. See chapter on Egypt in Victor Robinson's Story of Medicine

Akhnaton



Nefertiti



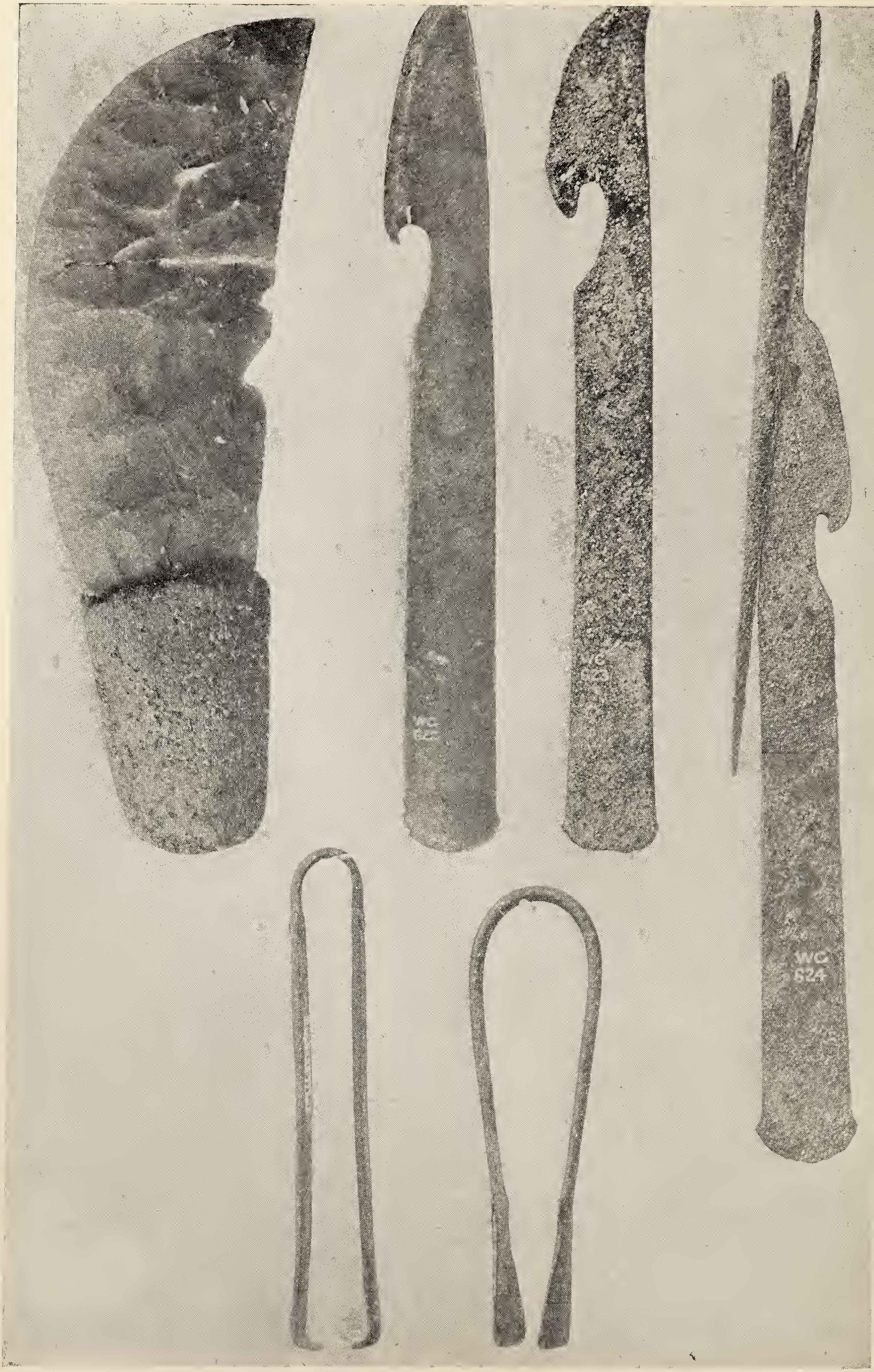
Fragment of Papyrus in Leipzig Collection

THE FIRST PICTURE OF POLIOMYELITIS

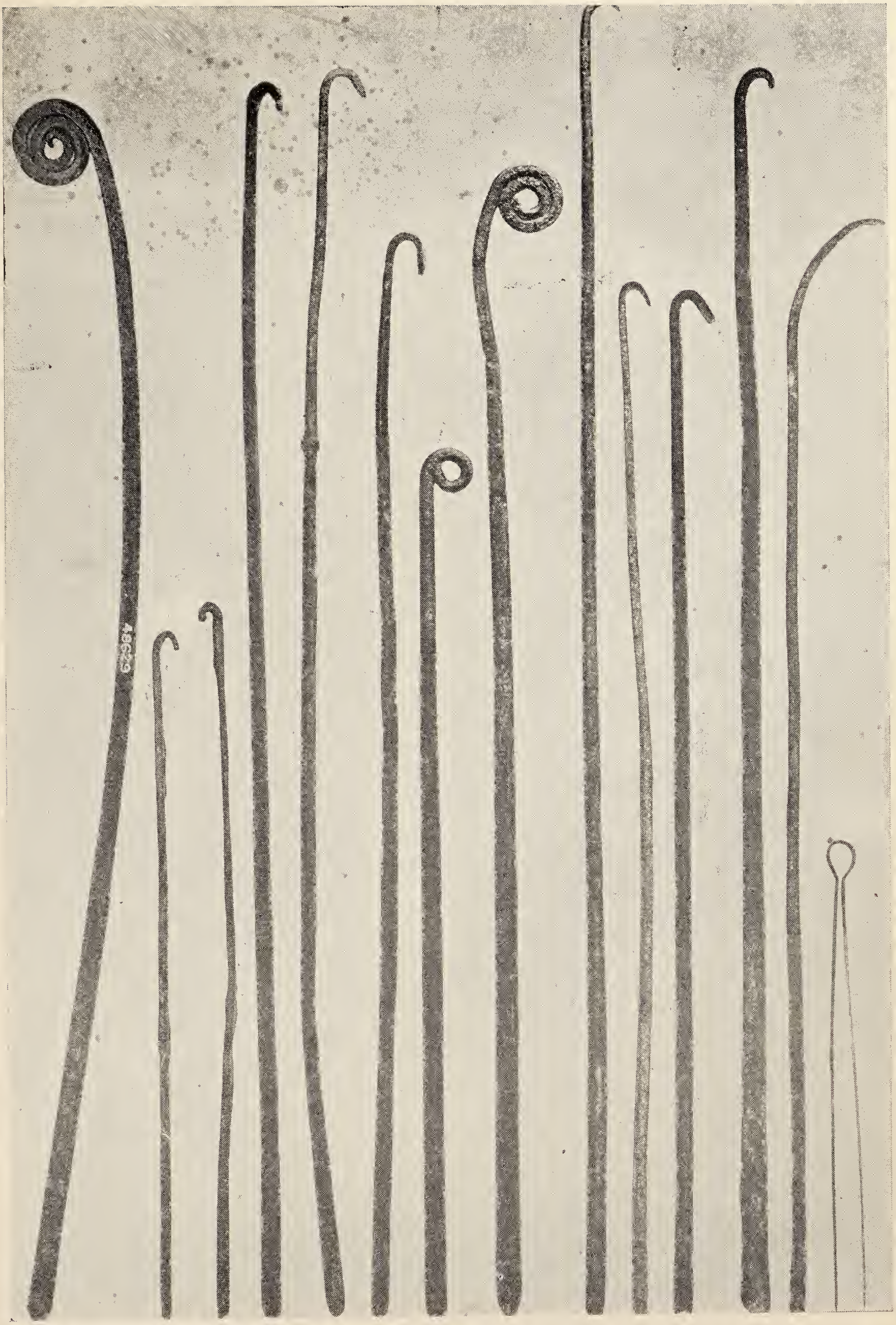
From an Egyptian Stele About 3500 Years Old

POTT'S DISEASE IN ANCIENT EGYPT

Lateral view of priest of Ammon, 1000 B.C., exhibiting the characteristic spinal protrusion of Pott's disease. Drawn by Mrs. Cecil M. Firth for Grafton Elliot Smith and Marc Armand Ruffer's contribution to Sudhoff and Sticker's Zur historischen Biologie der Krankheitserreger, Giessen, 1910.



INSTRUMENTS FOR MUMMIFICATION



INSTRUMENTS FOR MUMMIFICATION

Egyptian Viscera Jars

in which organs were kept during the process of mummification. Now in the museum of Cairo.

SPECIMEN CHRONOLOGY

Goiter Chronology

PREHISTORIC ERA.—Burnt sponges and sea-weed ashes (iodides) used by Chinese for goiter.

—Hindu incantations against goiter.

ROMAN ERA.—Caesar speaks of big neck among the Gauls as one of their characteristics.

—Romans recognize that slaves with bulging eyes fatigue readily.

—Prevalence of goiter in Switzerland is seen from the question of Juvenal: "Who marvels at goiter in the Alps?"

—Celsus describes the technique for the removal of bronchocele (goiter).

—Pliny says goiter is caused by impurities in water: "Only men and swine are subject to swellings in the throat, which are mostly caused by the noxious quality of the water they drink."

—Vague illusions to the thyroid in Galen (*De Voce*).

MIDDLE AGES.—Reference of Paulus Aegineta to bronchocele (no increase of knowledge of thyroid diseases until the Renaissance).

16TH CENTURY.—Paracelsus is the first to establish relationship between cretinism and endemic goiter.

—Vesalius describes the thyroid (*Fabrica*, 1543).

1656—Thomas Wharton names the thyroid and gives the first satisfactory description of its anatomy (*Adenographia*).

1769—T. Prosser's "An account and method of cure of the bronchocele, or Derby neck."

1776—Haller classifies thyroid, thymus and spleen as glands without ducts, pouring a special fluid into the blood.

1786—Caleb Hillier Parry writes the original account of exophthalmic goiter (Parry's disease).

1792—Essay on Goiter and Cretinism, by François-Emmanuel Fodéré (1764-1835).

1800—Publication of Benjamin Smith Barton's "Memoir concerning the disease of goiter, as it prevails in different parts of North America" (published by the author).

—Publication of Fodéré's Treatise on Goiter and Cretinism.

1802—Giuseppe Flajani describes the goiter and cardiac palpitation of two cases of bronchocele or *gozzo* (Flajani's disease).

1811—Bernard Courtois experiments in extracting alkali from sea-weed, and discovers iodine.

1820—Jean François Coindet, reasoning that iodine is the active constituent of burnt sponge (Fyfe had isolated iodine from sponges) introduces it as a remedy for goiter.

1822—Caleb Hillier Parry, of Bath, dies at the age of sixty-seven.

1835—Robert James Graves describes exophthalmic goiter (Graves' disease).

1836—Astley Cooper's notes on the structure of the thyroid gland in man and animals.

1840—Carl Adolph Basedow, of Merseburg, describes exophthalmic goiter (Basedow's disease), calling attention to the three cardinal symptoms: the swelling, exophthalmos, and tachycardia (Merseburg triad).

1850—Thomas Blizard Curling's "symmetric swellings of fat tissue at the sides of the neck connected with defective cerebral development," is the first reference to the condition later known as myxedema.

1853—Robert James Graves, of Dublin, dies at the age of fifty-seven.

1854—Carl Adolph Basedow dies at the age of fifty-five.

1856—Moritz Schiff removes the thyroid of various animals (first thyroidectomies).

1863—Charcot describes the fourth cardinal symptom of exophthalmic goiter, the tremor.

1873—William Withey Gull, of Colchester, England, describes the condition later known as myxedema. ("On a cretinoid state supervening in adult life in women").

1874—P. H. Watson is the first to excise the thyroid for exophthalmic goiter.

1878—W. M. Ord introduces the term myxedema ("On myxedema, a term proposed to be applied to the cretinoid affection occasionally observed in middle-aged women").

1883—J. L. Reverdin and Theodor Kocher treat exophthalmic goiter by total thyroidectomy and discover the thyroid to be a vital organ.

—Publication of Kocher's Cachexia Thyropriva.

—Investigations of H. and E. Bircher.

1884—Victor Horsley is the first to investigate the thyroid of monkeys.

—Moritz Schiff demonstrates that the symptoms of cachexia thyropriva following thyroidectomy can be prevented by a previous graft of thyroid substance, or the administration of thyroid hypodermically or by mouth.

1886—Thyrogenic theory of Moebius: "Graves' disease is an intoxication of the body by a morbid activity of the thyroid gland."

1891—George R. Murray begins to use hypodermic injections of thyroid gland in the treatment of hypothyroidism: "The symptoms of the disease having thus been traced to loss of the thyroid gland, the next advance was in the direction of supplying the deficiency. Schiff had already shown that the usual fatal result of thyroidectomy in the dog could be averted by a preliminary transplantation of another thyroid gland into the abdomen of the animal, and von Eiselsberg proved that the same result could be obtained in the cat, provided the graft was successful. Quite independently, 1890, thyroid grafting was suggested by Sir Victor Horsley as a method of arresting the disease in man. This suggestion was acted upon by several surgeons, especially by Bettencourt and Serrano, who noticed that in their case the operation was immediately followed by improvement, which they attributed to absorption of the juice of the transplanted thyroid gland. This observation appeared to me to be extremely important, as it indicated that the thyroid gland carried on its function by means of an internal secretion. I, therefore, concluded that if this was the case the regular use of the secretion, obtained in the form of an extract of the gland, would remove the symptoms of myxedema, and suggested this line of treatment at a meeting of the Northumberland and Durham Medical Society in February 1891. In order to test this a glycerin extract of the sheep's thyroid gland was prepared, and injected at intervals beneath the skin so as to ensure its absorption by the lymphatics in the same manner as the normal secretion is conveyed into the circulation from the healthy gland. The symptoms of myxedema in the first case I treated in this manner rapidly disappeared, thus proving that the thyroid gland is a true internal secretory gland, and that the thyroid extract is a specific remedy for myxedema. The following year it was shown by Howitz, of Copenhagen, and by Dr. Hector Mackenzie and Dr. E. L. Fox, in England, that the same results could be obtained by the simple method of giving thyroid extract or the raw gland itself by the mouth."

—Researches of Eugene Gley.

1893—Friedrich Müller makes first metabolic studies on exophthalmic goiter patients.

1895—Eugen Bauman discovers that iodine is a normal constituent of the thyroid gland.

—Magnus-Levy demonstrates that metabolism is increased in exophthalmic goiter and decreased in myxedema.

—George Dock investigates goiter in Michigan.

—Edward Lyman Munson reports the goiter situation among the Indians.

1896—William Stewart Halstead shows in his experimental study of the thyroid of dogs, that if the gland is removed before pregnancy or during its early stages, and rigid precautions are taken to prevent absorption of iodine, the pups at birth will have enlarged thyroids (hyperplasia will not result if available iodine is present).

—Moritz Schiff (of Frankfort, for twenty years professor at Geneva) dies at the age of seventy-three.

1897—Referring to the thyroid treatment of cretinism, William Osler writes: "Not the magic wand of Prospero or the brave kiss of the daughter of Hippocrates ever effected such a change as that which we are now enabled to make in these unfortunate victims, doomed heretofore to live in hopeless imbecility, an unspeakable affliction to their parents and relatives."

1902—F. Pineles differentiates endemic and sporadic cretinism.

1903—The toxic-neurogenic theory of Charles E. de M. Sajous, as the explanation of the etiology of exophthalmic goiter.

1906—Erwin Payr successfully transplants a part of a mother's thyroid to the spleen of her myxedematous daughter.

1907—David Marine (born at Whiteleysburg, Md., 1880; M. D., Johns Hopkins, 1905), teaches that goiter is a deficiency disease, that iodine is necessary for the normal function of the thyroid, and that in active hyperplasia the amount of iodine is reduced.

1908—A cretin whom Hector Mackenzie has treated since the age of eleven, becomes a university student.

1909—Charles Horace Mayo becomes identified with thyroid surgery.

1910—Edward Calvin Kendall (born S. Norwalk, Conn., 1886; Ph.D., Columbia, 1910), begins his investigations of the thyroid as research chemist with Parke, Davis & Co.

—David Marine and C. H. Lenhart completely prevent simple goiter in several hatcheries by adding small amounts of tincture of iodine to the water.

1912—J. F. Gudernatsch discovers that feeding thyroid to tadpoles causes precocious differentiation of the body, but suppresses further growth.

1913—Henry Stanley Plummer (Mayo Clinic) on the clinical and pathological relationships of simple and exophthalmic goiter.

—The Milroy lectures, on the Etiology of Endemic Goiter, by Robert McCarrison.

—George W. Crile's kinetic theory of exophthalmic goiter.

1914—Daniel Connolly Hall publishes his extensive report of the prevalence of goiter in the Northwest, based on the examination of 3339 students entering the University of Washington.

1916—Studies in the basal metabolism of exophthalmic goiter by Eugene Floyd DuBois (born Staten Island, 1882; director Russell Sage Institute of Pathology, 1913).

—Kendall (since 1914 at the Mayo Clinic) isolates the iodine-containing hormone, thyroxin.

—W. B. Cannon and J. McKeen Cattell investigate the secretory innervation of the thyroid gland, and the influence of the adrenal secretion on the thyroid.

—David Marine and Oliver Perry Kimball (medical student) explain the principle of goiter prevention to the superintendent of schools of Akron, Ohio, H. V. Hotchkiss, who promises his support if the local medical society approves. The Summit County Medical Association sends the following message to the school board: "The idea of prevention of goiter as outlined can do no harm and may do good. We are in favor of seeing it carried out."

1917—Publication of The Thyroid Gland in Health and Disease, by Robert McCarrison, of the Indian Medical Service. "In some Himalayan villages the disease (endemic goiter) is so common that it is difficult to find a man, woman or child not suffering from the deformity."

—J. M. Rogoff and David Marine's "Attempts to produce a substance with thyroid-like activity by the artificial iodization of proteins."

—Campaign for the prevention of simple goiter commenced by David Marine and O. P. Kimball among the school girls of Akron, Ohio. Goiter record is attached to the school record of each girl pupil.

—E. G. Smith is able to prevent goiter in hogs by feeding potassium iodide to the pregnant sow.

1918—Publication of Andre Crotti's "Thyroid and Thymus."

—Emil Goetsch describes the adrenalin sensitization test for hyperthyroidism.

—O. P. Kimball (born 1887), receives M.D. from Western Reserve University.

—R. Klinger, of Zurich, who reports that in some of the schools 100 per cent of the children are goitrous, carries out goiter prevention in Switzerland, confirming the results obtained in Akron.

1919—William Stewart Halstead tells the operative story of goiter.

—Kendall's "Isolation of the iodine compound which occurs in the thyroid."

1920—George R. Murray publishes "Life-history of first case of myxedema treated by thyroid extract."

—Kurt Kottman, of Berne, Switzerland, describes serum test for hyperthyroidism.

1921—Fukushima reports that the total weight of the thyroid of the Japanese is considerably less than that of the European, but contains a much larger amount of iodine.

1922—George W. Crile and associates discuss the thyroid gland (edited by Amy F. Rowland). Crile and Lower teach that the diagnosis of hyperthyroidism is the indication for thyroidectomy.

—Jesse F. McClendon (born Lanette, Ala., 1880; Ph.D., U. of Pa., 1906; professor of physiological chemistry, U. of Minn., 1920) demonstrates that the incidence of goiter is high where the iodine content of the water is low.

1923—H. K. Cushing Laboratory of Experimental Medicine of Western Reserve University, publishes Studies on the Prevention of Simple Goiter, with contributions by David Marine, C. H. Lenhart, and O. P. Kimball. "In these endemic goiter districts, if every woman would keep her thyroid saturated with iodine during every pregnancy, she would not develop goiter, nor would there be any tendency toward goiter formation in the thyroid of her child. This would save two of the goiter periods in the life of any individual. Then if every girl would keep her thyroid saturated with iodine during adolescence, none would develop goiter."

1924—Publication of Israel Bram's "Goiter: Nonsurgical types and treatment."

1925—The Goiter Number of Medical Life.

The Photostat and its Value to Students of Medical History

By Charles Perry Fisher

Librarian, College of Physicians of Philadelphia

The Photostat, as perfected in its present form, was placed on the market in 1911, and the many possibilities of this machine, which embodies the simplest method as yet devised for making photographic copies direct upon paper without the necessity of preparing a transparent negative—copies exactly the size of the original; or enlargements; or reductions as desired; without previous knowledge of photography, as its operation is almost entirely mechanical; prints that are absolutely permanent and further that may be presented as good legal evidence—were quickly appreciated. Banks, Insurance Companies, Manufacturing Plants and several Departments of the United States Government at Washington were using the Photostat before 1912 and two of the largest libraries in the country (the Library of Congress and the New York Public Library), commenced its use during that year. Of course, as can be readily understood, the work accomplished was what might be termed "purely commercial," there being no thought at that time, as far as I know, of using the Photostat to make reproductions of valuable documents and books in order that the originals might be preserved and yet the material be open for consultation. In a comparatively short time, however, various Universities and Historical Societies of the country had learned of the practicability of the Photostat, and the work of reproducing manuscripts and printed curios of great rarity was under way; but not until the last few years, I believe, was any attempt made to reproduce complete works or collections; probably, even with the comparative low cost of production with the Photostat, the question of expense was the main obstacle. The City of Philadelphia, for instance, in order to reproduce certain valuable documents had a special size Photostat constructed that carried sensitized paper 25 x 30 inches; this meant a considerable increase in expense for paper and chemicals, so after the particular work was completed the machine was exchanged for one of the regular sizes. Recently, this is within the past two years, I understand that at Brown University and pos-

sibly in two of our larger cities, work has commenced upon the Photostatic reproduction of the files of early newspapers; this is a work of paramount importance in preserving for future generations that intimate phase of history that would otherwise be lost. So in every branch of science, in every institution that has a library, a museum, a collection or whatsoever it may be called, that contains printed or manuscript material that could not be replaced, Photostat reproduction should be seriously considered, and not only a single copy, but several copies be made, so that there could be exchanges with other libraries or institutions and thus this valuable material be made more generally available to investigators and students.

In medicine, the College of Physicians of Philadelphia, was the pioneer in the use of the Photostat (November 1, 1916), and from the outset the instructions of the Library committee were that after supplying the current demands of the fellows of the college and the physicians of Philadelphia and elsewhere, the operating time was to be given to the reproductions of incunabula, rare books and manuscript documents; so that this material would be available for use, while the originals were placed, for their protection, in steel cases in the fireproof stacks. These instructions have been and are being carried out; complete copies of two hundred and ninety-five incunabula have been printed and bound so far; also, as the opportunity occurred, copies of several other extremely rare books have been made, such as the first edition of Harvey's "De motu cordis et sanguinis in animalibus," 1628; Hall's "Select Observations on English bodies of eminent persons in desperate diseases," 1679; Panarola's "Aerologia," 1642, etc. In addition, all documents, diplomas, etc., with autographs and manuscript notes, that were on exhibition, framed on the walls or otherwise, and which showed the writing fading out from exposure to the light, have been replaced with Photostat copies and the originals filed in envelopes in steel cases; the same with framed photographs of prominent physicians, the originals have been taken out of the frames for preservation and replaced with Photostat copies. In a number of cases, enlarged portraits have been made from small engraved prints of prominent physicians of the past, with quite remarkable success, even from an artistic standpoint, and well worthy of framing. Now it should be understood that all the Photostat work done in the

Library of the College of Physicians can be duplicated at will without handling the original material; the first printing with the Photostat is what in photography is termed a negative although on account of a prism on the lens, the objects or letters are not reversed; the colors are, however, that is to say what was white in the original is black in the negative and vice versa; therefore a second print is made from the negative which results in an exact copy of the original; except, possibly in the color of the paper. All negatives, whether of books, documents, or portraits, are kept in manila envelopes, labelled and catalogued. Think how the Photostat has enlarged the field of research in the history of medicine in this one library; how the student can consult without question such rare curios as the first book printed on Pharmacy, Albucasis, 1471; the first book on the Diseases of Children, Bagellardus à Flumiore, second edition, 1487; the first book on the Diseases of the Eye, Grassi (1474) ; the first book on Diet, Isaac, 1487; the first Medical Dictionary, Januensis, 1473; first book on Generation, Scott first dated edition 1477, and so on. Think what this means to the investigator and the real student in research and in the history of medicine, when the great libraries, not only of this country, but of the world, make use of the Photostat with the same facility as they now make use of the typewriter. Any statement that is still in existence in manuscript or print, that is in the possession of a library, can be verified by the investigator, by obtaining a Photostat copy of the original, at a trifling cost. No longer, as is generally found to be the case, will it be necessary, or will there be an excuse, for the writer to quote a statement, without any knowledge of its accuracy, simply because he finds it quoted, always in the same form, in one book or another for generations back. What he quotes, he can quote from the original source without fear of question or criticism. It must be remembered also that what has been said does not refer solely to old books. All references or quotations could and should be made from the originals, and whether from the literature of ancient times or the present, are all in the making of history.

There are four models in the all-metal Photostat, with all parts standardized so that replacements can be made without delay.

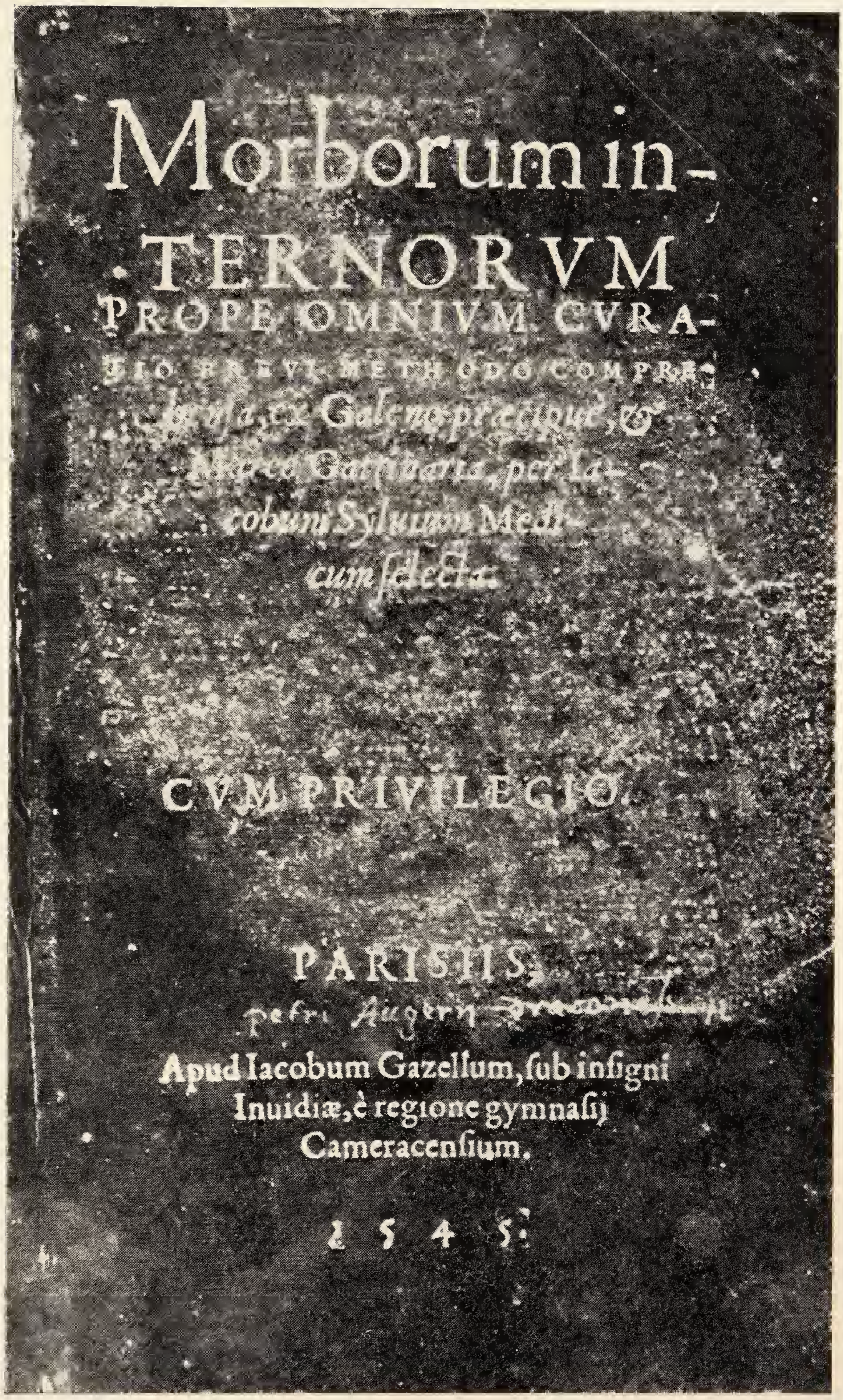
In closing I wish to say that the criticism has been made that the reproduction of these rare old books and priceless manuscripts

would cheapen their value. That this is a mistaken idea, I trust that all who read this will agree. The original will always be the original and its value lies in that fact, whether the ownership be with a collector, an institution, or a dealer. A more widespread knowledge of the existence of a curio of any kind should increase, and not detract, from its value, whether that value is considered from a commercial standpoint or that of possession.

Photostatic Reproduction

of the Section on Asthma in Jacobus Sylvius' (Jacques Dubois) Morborum internorum [1545]. Jacobus Sylvius [1478-1555], not to be confused with his more attractive namesake, the Dutch Franciscus Sylvius [1614-72], was the most aggressive and harshest opponent of the Renaissance in anatomy and physiology, ushered in by his rebellious pupils, Vesalius and Servetus, whom Sylvius hated and denounced. (See Frank Baker's "The Two Sylviuses," Johns Hopkins Hospital Bulletin, November 1909). The first Sylvius' knowledge of Galenic anatomy was unsurpassed, and although his character was unsympathetic (the genial Professor Baker presents him in as kindly a light as possible) he cannot be neglected by students of medical history.

It will be noticed that Sylvius placed his section on Asthma between Tussis and Pleuritis. The smudge on the title-page is in no way the fault of the photostat, being in the copy from which the photostat was taken. (See Morris H. Kahn's Historical Survey of our Knowledge of Bronchial Asthma, Medical Life, 1928).



Morborum in-
TERNORVM
PROPE OMNIVM CVRA-
TIO BREVI METHODO COMPRE-
hensa, ex Galeno præcipue, &
Marco Gattinaria, per Ia-
cobum Syluium Medi-
cum selecta.

CVM PRIVILEGIO.

PARISIIS,

petri Augerin

Apud Iacobum Gazellum, ſub inſigni
Inuidiæ, è regione gymnaſij
Cameracenſium.

1545.

ſue in curatione phthiſis, mirum in pulmone roborando: ſyrupum glycyrrhizæ: ſumat autẽ ſæpe, vt prius cochleario per ſe, vel cum decocto vuarũ paſſarum, ficuũ, glycyrrhizæ, & aliorum pulmonariorum: ſumat item penidia & diairis Nicolai ad ciceris magnitudinem, Foris autẽ illinat oleum amygdalarum dulcium per ſe, aut etiam cum butyro recenti nõ ſalſo, & croco pauco, vel etiam oleo, & muccagine ſe. lini, fœnigræci, maluæ, althææ.

6 Materiam reliquam digerentibus, vt trochiſcis, & ſuffitibus Raſis à Matthæo Gradi expertis.

Aſthmatis curatio.

ASthma, id eſt, anhelatio à pituita craſſa trachias arterias obſtruente (Nam quę à ſanguine fit anguſtia, & inde ſpirandi difficultas, in ſputo ſanguinis: quæ à peripneumonia in capite de ipſa, quæ ab vlcere pulmonis, in capite de phthiſi: quę à luxatis intro ſpinæ ſpondylis, capite de gib boſitate dicetur) curatur ſex remediorum generibus.

1 Victus ratione calida ſicca: vt, aëre: vt cibo, carnibus ſcilicet toſtis vel aſſis, non pinguibus neque neruoſis: vt, potu in paſtu quidem parco, poſt paſtus autem nullo, etiam ſi vehementer ſititur ob cordis calorem minus quàm exigit, refrigeratum. Potus enim tunc ventriculo diſtenſo diaphragma premit, & reſpirandi au-

get difficultatem: potest tamen bibere vbi cibus prior ventriculum iam egressus est. potest verò etiã prius os potu lauare, & gargarizare, & liquoris sputum promouentis aliquid in asperas arterias inspiratu trahere.

2 Materiam in cerebro, pulmone, vel partibus aliis transmittentibus collectam, apparantibus: calfacientibus, humectantibus, incidentibus, tenuantibus, tergentibus. Ne verò calidis multum initiò vtere, quia tenui resoluto crassum expuitioni ineptum relinquunt. ne etiam in hoc affectu chronico iisdem continẽter vtere: quia quibus remediis natura assuescit, ea contemnit, quòd ab assuetis non fiat passio. Adhæc quanuis hæc medicamẽta qualitatibus manifestis conueniant: diuersam tamen habent proprietatem occultam, quâ hæc illis corporibus, illa aliis magis conueniant & conferant. Sunt enim medicamẽtis cũ corporibus totius substantiæ proprietates, & familiares, & repugnantes, quę sola experientia noscũtur. Conueniunt igitur syrupi glycyrrhizę, hyssopi, prassij, & his valentiores, de duabus, & de quinque radicibus: oxymeli item simplex, cõpositum, & valentius scilliticum cum duplo aquarum hyssopi, fœniculi, vel decocti radicis helenij, vuarum passarum, dactylorum, adiantorũ & cæterorum thoracicorum.

Gal. in simpl. passim.

3 Materiam si multa est, purgantibus (si enim tam pauca est, vt per sputa excerni possit, pur-

ga-

gatione non opus eſt)vt,agarico trochiſcato, pilulis ex agarico Meſuæ (is enim cerebrum, thoracem,pulmones,tacito conſenſu mirè pur gat) pilulis cocciis pituitam à cerebro vacuātibus per ſe à drachma vna ad ſcript. quatuor, vel ipſarum, & pilularum ex agarico, aut agarici trochiſcati ana ſcript.duobus, vel ∈. indo ad ſemunciam,vel expreſſo drach.duarum agarici,cum ſalis gemmę, & zingiberis ana ſcriptulo vno,decē horis infuſarum in aquæ hyſſopi,& ſcabioſæ quantitate ſufficienti,addendo ∈.indi drachmas duas,ſyrupi glycyrrhizæ vnciam vnam.Vt tamen à pulmonibus tādem attrahant purgatoria,in pilulis ſunt efficaciora,vt quæ mora in ventriculo longâ à remotis partibus attrahūt.Conueniūt & aſthmati à catarrho pilulæ aromaticæ,de hiera ſimplici,vel compoſita, cū agarico ſemper,vt omniū ſimul dētur ſcriptula quatuor, quarto aut ſexto quoque die,horâ ſomni.Poteſt etiam elleborus & colocynthis, aut potius hiera diacolocynthidos his tandem exhiberi,parata multum materia,vt facilius vacuetur.Sæpe autem repetenda purgatio eſt ob morbi longitudinem, modò ne purges dum velut in pulmone feruet, & exundat ſurſum materia per quoſdam paroxyſmos, & ſæpe certis periodis repetentes.

Acceſſionis enim tempore medicamēto purgante materiam non agitabis,ne largius in pulmones fluat,& ſuffocet,ſed blandè ſputum tūc

prouocabis, aut per cucurbitulas, pauló ſuprà renum ſitum affixas, & recto corpore reuelles materiam ad arteriæ aſperæ truncum, confertim ruentem, & ſuffocationis periculum afferentem.

4 Auertentibus remediis: vt, errhinis, apophlegmatiſmis, cauſticis, & cæteris antè in catarrho & tuſſi deſcriptis.

5 Sputa promouentibus, hoc eſt, thoracem roborantibus, arterias aſperas dilatantibus, & incidẽtibus: hisq́; vel ſimplicibus: vt, glycyrrhiza, vuis paſſis, ficis ſiccis, myxis zizyphis, adiantis, hyſſopo, ſcabioſa, rad. helenij, ariſtolochiæ rotundæ, foliis, & ſemine vrticę, & cæteris, dulcibus, nitroſis, ſalſis, amaris, acribus: vel cõpoſitis ex his, & ſimilibus ſyrupis, electariis, eclegmatis: quale ex braſſica & ex pulmone vulpis factũ, ab oĩbus ſcriptoribus celebratur proprietate pulmones iuuare, vti pulueris ericij ſylueſtris drachmæ duæ ſæpe ſumptæ. Radix quoque ari cruda, vel potius elixa, aut ſub cineribus aſſata, trita, & ſyrupis thoracicis miſta, ſputum efficaciſſimè promouet: ſi eius, exempli gratia, ſemuncia cum eclegmatis de pino: & de pulmone vulpis, ana drachmas ſex, cum ſyrup. glycyrrhizę miſceantur: cui addũt quidã vuas paſſas purgatas, ficus, dactylos, penidia, hyſſopum, adiantũ. Foris autem corpus linatur oleo amygdal. dulcium, butyro recenti, cum pauco croci, & linteis aſperis molliuſculè

culè fricetur, vt per poros apertos aliquid materiæ exhalet.

6 Siccantibus & dissipantibus materiæ reliquias suffitu cum thure, sulphure purgato, & etiam arsenico: quod mirũ in id Gentilis prædicat, etiam si sit deleterium, & ob id vix vtendum, nisi ritè castigetur: sumptis etiam theriaca, mythridatio, diamoscho dulci & amaro, pliris arcotico, & similibus.

Pleuritidis curatio.

PLeuritis vera, & resolui, & sputis perpurgari apta, curatur sex remediorum generibus: phlegmonem augeri prohibentibus, & quod eius iam est genitũ resoluẽtibus.

1 Victus ratione ad quartum vsque diem tenuis, si vires ferre possunt, vt potione ptissanę, vel ptissana tota, aut colata, seu aqua hordei, & hordeato curiosè cocto, vt voluit Hipp. deinde ad septimum vsque pane loto, vt salis & fermenti calor tollatur, & ex aqua alia percocto, portione butyri & sacchari exigua, ad saporis gratiam adiecta: post diẽ septimũ, amygdalatum panis, aut hordeum, ex iure pulli coctum. Vini autem loco bibat decoctum hordei, vel aquam saccharatam. Vinum autem nunquam ante declinationem: quod si vires nimis collabuntur, paulò pleniore victu vtendum est: vt, pullorum, vel aliarum carnium contuso cum mica panis, vel expresso, vel cõsummato, quod

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